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AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 15, NO. 10. WEEKLY. | NEW YORK, THURSDAY, MARCH 10, 1892. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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Locomotive Piston Ring Turning Machine.

The illustrations on this page are of a machine which is especially designed for making piston rings for locomotives, though, of course, by the use of other tools in the turret, it is adapted to a large variety of work of similar nature. The machine resembles the upright turret head boring machine, but has the turret slide mounted upon a saddle which can be fed across the table, thus adapting the machine to turning or facing as well as boring.

The perspective view shows the machine with a piston ring casting bolted to the table, Fig. 1 showing the first operation, which is to face off the upper edge of the ring. Fig. 2 shows the second operation, which is to take a roughing cut inside and out simultaneously, Fig. 3 being the finishing cut, while at Fig. 4 is shown the cutting-off tool, in which there are fitted two cutters which advance towards each other from opposite sides. All the tools necessary for finishing a ring are placed in the turret, and brought into action successively, as shown.

The machine is intended for rings from 12″ to 24″ diameter, and is so proportioned and arranged that the heaviest cuts can be taken without springing or vibration. The table is mounted upon a spindle, which is 8″ diameter, and there is an outer bearing 16″ diameter, which takes the vertical thrust. The table is driven by worm teeth, which are accurately cut at the periphery of the table, these teeth and the worm which drives them being immersed in oil at all times.

There are four speeds for the table, and six rates of feed, a clutch being provided which, by the movement of a lever, doubles the feed for finishing.

It will be seen that the machine has several advantages over the lathe for this work, among which may be mentioned the greater convenience of fastening and truing the casting on the table, and much greater rigidity, owing to the very large spindle and thrust bearing.

It is built by the Richards Machine Tool Company, Suffolk House, Laurence, Pountney Hill, London, E. C., England.

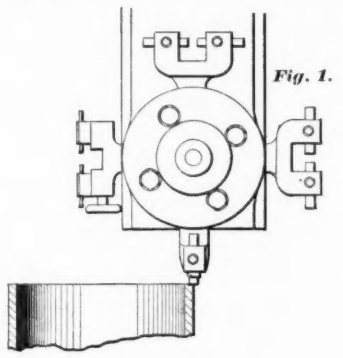
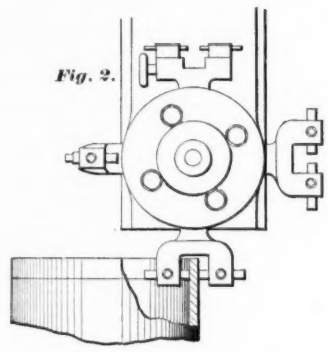


Fig. 1.



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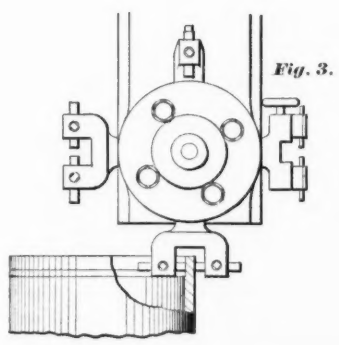


Fig. 3.

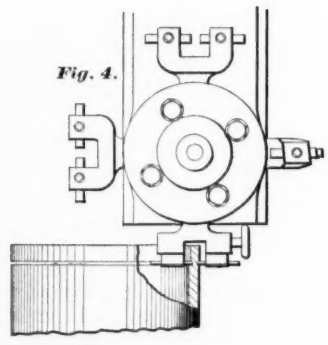
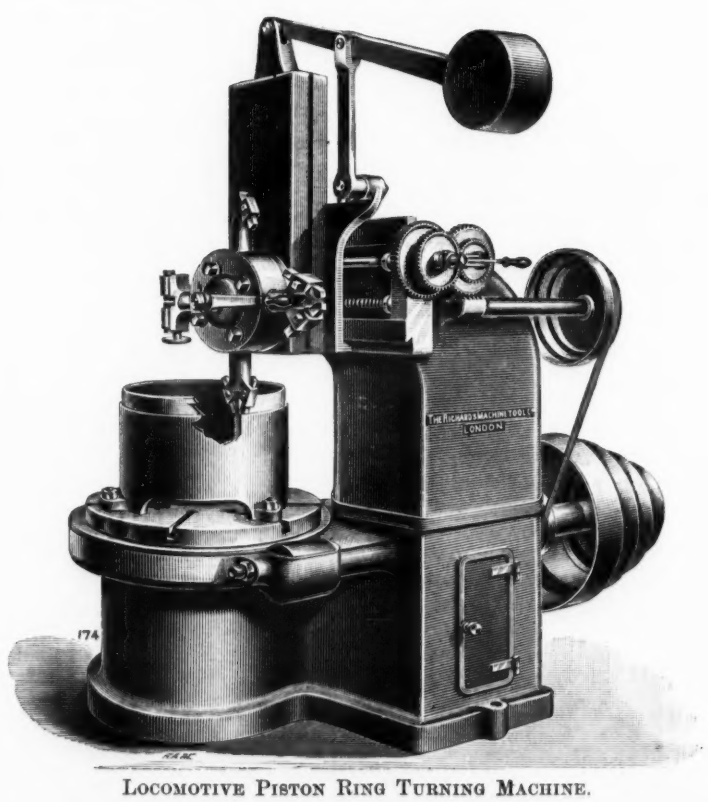


Fig. 4.



LOCOMOTIVE PISTON RING TURNING MACHINE.

Attempt to Invent a New Motor.

BY I. MCKIM CHASE.

About fourteen years ago Prof. John Gamgee, of England, a pioneer in the art of artificial refrigeration, who advocated the commercial importance of the artificial manufacture of ice when few believed it could be so produced to economically compete with the natural product, began experiments in this country to practically demonstrate the commercial importance of artificial refrigeration, and also to demonstrate the practicability of what he termed the zerometer.

I well remember the animated discussions that occurred during the progress of the experiments regarding the merits of the motor, and with what earnestness and ability—for he was a gentleman of high attainments—the Professor would maintain his position when sometimes opposed by adversaries of ability.

The writer then occupied a position where he could materially assist the Professor, and he encouraged him in his undertaking, not that he expected the success of the motor, of which he was skeptical, but for the knowledge to be acquired from the experiments which could be gained in no other way. Experiments—even when they fail to accomplish the object sought—are always instructive.

Those familiar with devices for transforming energy into mechanical work are acquainted with the doctrine of reversibility of the perfect heat engine first propounded by Sadi Carnot in 1824, but which remained in obscurity until the science of thermodynamics was sufficiently developed to enable its truth to be recognized and appreciated. Carnot argued that a heat engine should be reversible if it is adjusted to do as much work as it is capable of doing; that if a heat engine received a certain quantity of heat and gave out a definite amount of work, if the engine was perfect it could be reversed, and by the application of the same work would give back to its source the exact quantity of heat that had first produced the work. Carnot was wont to illustrate his theory by referring to the arrangement for utilizing the fall of water where a pipe led from a reservoir on a hillside to a turbine, and thence by a tail-race to the sea level.

The mean sea level is the lowest point to which the water can fall, and this may be compared to the absolute zero of temperature. If the turbine is situated half way between the reservoir and sea level—which is equivalent to halving the temperature of a gas—then only half of the theoretical energy is possible to be utilized. In other words, the quantity of heat given out by a gas as it cools is in direct proportion to a change of temperature. It is obvious the only way to get all the energy possible out of a gas is to cool it down to absolute zero, which is 462.2° below the zero of Fahrenheit.

Gamgee contended his theory of the zerometer in no way controverted the theory of Carnot, the truth of which he appreciated; that, instead of having his source in a reservoir elevated above the sea level, as with Carnot, his source was at the sea level; and if he obtained the same fall from there as obtained from the elevated reservoir to the sea level, his machine should be as efficient. In the case of the zerometer, he proposed to maintain a range of temperature between the initial and final action of the gas, and would begin with the normal temperature at the surface of the earth, and reduce the temperature from there, whereas the usual practice is to begin with a temperature above the normal at the earth's surface, and reduce towards normal. As Gamgee was wont to say, instead of maintaining a hot boiler he proposed to maintain a cold condenser.

As an illustration, suppose in the ordinary heat engine the gas is taken in at 592° Fahr. absolute, and is exhausted at a normal temperature of 512°, there will be a fall of 80° in temperature.

Now suppose in the case of the zerometer the gas is received at the normal temperature of 512° absolute, and is reduced to 432°, which is about the boiling point of ammonia under atmospheric pressure, there will also be a reduction of 80°. Gamgee reasoned from this fact that the two machines should be of equal efficiency.

In the machine as constructed, there were three rotary engines of similar type on a shaft common to them all. One was used as a steam engine, one as an ammonia pump, and one as an ammonia engine. There was also the necessary surface condenser and other appliances of refrigerating machines.

When used for the manufacture of ice, it proved to be a very efficient machine. The refrigerating medium was anhydrous ammonia.

In operation, steam was admitted to the engine, and a valve communicating with the liquid ammonia was opened, and the ammonia allowed to expand in the ammonia engine; in doing so, it performed part of the work of compression. The ammonia was finally returned to the condenser by the pump and there liquefied, when it was ready to repeat the cycle.

When the machine was prepared for the zerometer, the steam engine was disconnected, and the condenser employed as the source of power, or, as it was called, the high-pressure boiler. A supplemental condenser was added, which was called the low-pressure boiler. The induction of the ammonia engine was connected with the low pressure boiler and exhausted into a receptacle, to which the induction of the ammonia pump was connected. The eduction of the pump connected with the low-pressure boiler. An injector was introduced communicating with the two boilers, and

the bottom of the receptacle into which the engine exhausted connected with the injector. There was also a small pump for the purpose of passing liquid ammonia from the low to high-pressure boiler. The water, after circulating through the high-pressure boiler, was expected to have its temperature reduced by the expanding ammonia, and was afterwards circulated through the low-pressure boiler. It was calculated that the following temperatures would obtain in the different parts in operation when the normal temperature was 65° Fahr.: in the high-pressure boiler, 65°; in the low-pressure boiler and induction to engine, 55°; in the exhaust receptacle and induction to pump, 30°.

As thus prepared, the machine could not be made to revolve, because the second law of thermodynamics could not be circumvented by it. The attempt to make it operate was finally abandoned, and the machine prepared again for ice manufacture.

It was during the operation of this machine that the writer became fully impressed with two superior features the rotary possesses over the reciprocating engine.

The two greatest losses in the reciprocating engine arise from cylinder condensation and the unavoidable clearance. It is possible in the rotary to abolish clearance entirely and have the piston to wipe the cylinder out clean at every revolution. In the reciprocating engine, there is a change of temperature in the walls of the cylinder with every stroke of the piston. Steam is admitted of a higher and exhausted at a lower temperature with the alternating movement of the piston, the consequence is the temperature of the walls of the cylinder is not as high as that of the entering steam, nor as low as the exhaust, but remains somewhere between. When the steam enters and comes in contact with the colder surface, there is a condensation of steam resulting therefrom.

A rotary is an endless cylinder engine where the steam enters on one side of a division and is exhausted on the other, consequently the temperature of the walls where the steam enters may be maintained at that of the entering steam, and a fall in temperature occur towards the exhaust, corresponding to that of the steam.

The machine in operation presented a beautiful occult demonstration of the foregoing thesis.

The graduation of the frost accumulated on the outside of the ammonia engine and pump plainly indicated the progress of the expansion and compression of the ammonia taking place within.

Designing Mechanical Movements.

BY WM. S. ALDRICH.

However much light may be thrown upon the subject of invention, the exact process will always remain more or less obscured. But the developments that have been brought out in many lines of mechanical work would seem to indicate that there are by-paths to the royal road. And the great systematizing of our knowledge of mechanisms and the machinery of transmission leads us to hope that, at no distant day, the designing of mechanical movements, the invention of mechanism, will be by methods that are more natural and logical, and so more scientific, than have been employed. It has had more or less of the cut-and-try about it—a groping in the dark for something that has been too often little understood. Much less has it been known what others have done in the same line.

The invention of mechanism, to be made a truly scientific process, must rest upon and be developed along absolutely general principles. When these fundamental principles become recognized by the study of existing mechanisms, and by the researches which mathematical investigations make possible, then the foundation courses may be laid for a work of enduring success by the inventor who would build thereon. Too often invention becomes, as it were, a repeated putting down and comparing of the possible combinations which present themselves. *How* these possible combinations present themselves we cannot clearly define. That they do is a fact; and, moreover, it is common experience that the better preparation we have in recognizing the possibilities bound up in any new combination—to seize upon and hold fast the idea, and turn it to good account—becomes a measure of the extent to which we can somehow devise new combinations. Reuleaux writes that the process partially outlined by him "makes the finding of inventions easier only to those who have scientifically grasped their subject, while at the same time it places the goal they attempt to reach ever higher and higher. It does not decrease, but rather raises the intellectual work of the inventor, while it enables him to see more clearly, not only the object he wishes to attain, but also the means at his disposal for attaining it, and the best method of employing those means."

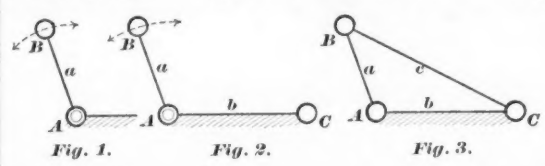


Fig. 1. Fig. 2. Fig. 3.

If the mechanical movements be examined in only a few of the wonderful mechanisms of modern inventions—printing presses, paper machinery, spinning, weaving and carding machines, and the mechanisms of machine tools—it becomes simply bewildering. And the current technical journals, as well as the publications of the United States and foreign Patent Offices, furnish abundant material and sufficient food for thought for all the days and nights yet to come in any man's life. But it does not stop here; for, while one is at work describing, developing, perfecting any given form, a hundred others are being brought to light with which he must needs be somewhat familiar. The case would be hopeless if we should to-day study each and every machine by itself, as was possible in the days when there were a few simple machines. We should very soon find identical movements, and their equivalent mechanisms throughout, and be under the necessity of early turning our attention more particularly to the study of the *motion*.

The term *mechanism* at first was applied more especially to the means used to alter or change the direction of motion, such as by wheels, links, belts and pulleys, with certain ratios of velocities. These two elements of motion—the directional relation and the velocity ratio—constitute what Willis and Rankine have termed the elements of comparative motion. And the modes of connection, or means of communicating the motion—such as by link work, wheel work or wrapping connectors like belts and chains—have formed somewhat of a basis for classifying mechanisms. While Willis carefully excluded from the science of pure mechanism all combinations not consisting of rigid elements, Rankine, on the other hand, included hydraulic connection as a possible means of communicating motion. And later there have been added pneumatic and electromagnetic means. For it has been clearly seen that the simple question of motion—that is, of the kinematics of the mechanism—remains the same, whatever the means employed. The work of Reuleaux in developing the kinematics of machinery has made possible a grasp of the whole subject from a new standpoint, namely, that of a systematic development of the machine problem, which not only forms a rational basis for the study of existing machines, but looks forward to the probable scientific development of new combinations, the invention of mechanisms, and the designing of mechanical movements.

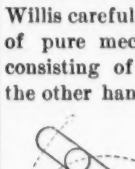


Fig. 6.

To look backward along the probable line of development, by which any particular mechanism has come to be as it is, may help in showing a way that might profitably be followed in working up to a combination of mechanism for any given specific purpose. Suppose we examine the elements of the quick-return motion of one of our modern machine tools. In one of its forms this mechanism is widely known as the Whitworth quick-return motion. It is not our purpose to show how Whitworth obtained it, even if it were his original invention. We wish simply to outline one way of the many possible lines of development of a quick return motion mechanism, and thus to indicate some of the steps that may be logically taken to develop any other simple mechanism for a definite purpose. The study of what has been done is always a great help in showing what may be done. Especially is this the case if it is possible to obtain some idea, however faint, of *how* any existing combination of mechanical movements could have been devised. It is of historical interest to note that the fundamental form of this Whitworth motion was used by Huyghens to represent, in his planetarium, in an approximate way, the variable motion of a planet in its elliptical orbit.

The problem of the quick-return motion, which we have selected, requires a mechanism which shall alter or change the continuous and uniform rotation of a given shaft into a to-and-fro motion, or reciprocating movement, such that the return stroke shall be made in less time than the advance stroke, by some definite ratio.

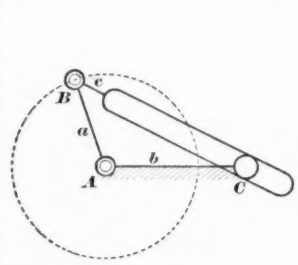


Fig. 4.

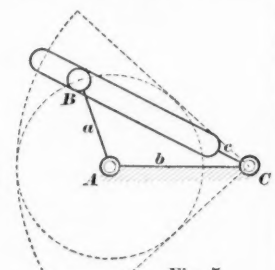


Fig. 5.

There is, therefore, a periodic change in the relation of the directions of motion, and a variable ratio of velocities. Moreover, we know that, in order to have the mechanism serve any useful purpose, all of the relative motions must be *constrained* (Reuleaux). That is, besides having a certain direction and a certain velocity, the motion must be completely determined at any instant. Especially is this needful in this mechanism, where there is a change of both direction and velocity.

It makes little difference where we begin, whether with a crank arm or a wheel, for the element of rotation, or whether we develop the work by a system of link work or a system of wheel work. At this stage we are not concerned so much with what particular train of mechanism shall be finally used as with the fundamental requirements of the problem. It would be possible to start at once with the simple crank and connecting rod mechanism of the steam engine. But some may doubt the propriety of beginning at so advanced a stage, even though we have here the rotation and reciprocation so desirable, but *not* variable time stroke reciprocation for the uniform rotation.

To the simple crank arm *a*, Fig. 1, capable of rotating uniformly about *A*, add another one, *b*, Fig. 2. Whether this is equal, greater, or less in length than *a*, will be seen to alter materially the later combinations. Connect *B* and *C* by a link *c*, Fig. 3. Whereas, in Fig. 2, there were two different rotations possible about *A*, now there is only one in Fig. 3, which represents a closed triangle rotating about one of its vertices; so we have not yet a mechanism. There must be some relative and constrained motion provided for between *a* and *b*, which may be done by opening out *c* into a slotted link, at either *C*, Fig. 4, or *B*, Fig. 5. In order to have completely constrained and determinate motion among these three elements, *a*, *b*, *c*, so as to constitute the combination a mechanism, some one of them must be fixed, as *b*. A slight modification would convert the mechanism of Fig. 4 into the typical form for an oscillating steam engine. For the quick-return motion we may have the slot at *B* or at *C*. Figs. 5, 6 and 7 show the slot at *B*, and with the fixed link *b*, respectively greater than, equal to, and less than the crank arm *a*. A connecting rod may be attached to the slotted link *c* at any point except its center of rotation, and the other end of this connecting rod, being guided in a definite path (usually a straight line) will have a slow-advance and a quick-return stroke.

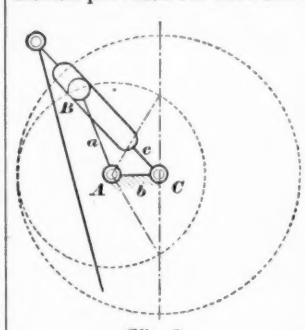


Fig. 7.

Simple diagrams have been used in building up the mechanisms; for it is a matter of machine design to stop at any one of them and clothe it with the form and proportions adapted to the performance of useful work in a machine. And in the process of designing a mechanical movement it is well to divest one's self of any difficulties and elaboration of details not requiring to be immediately met. But now let us pass on to the development of the simple diagramatic solution of Fig. 7, in some other form. Not that it is, as it stands, impracticable; though many of the steps in developing a given motion are often found to be of little immediate use, except to satisfy us that we have left no stone unturned. Replace by (or rather *expand* into) a disk *D*, the crank arm *a*, and drive it by belted or geared connection, Fig. 8. Then expand the shaft at *A* till it includes fully the link *b* and point *C*, Fig. 9. This is termed pin expansion, the fixed pin *A* being expanded into the fixed shaft *S*, on which the disk *D* loosely turns. The slotted link or slit lever *c* may be developed into an adjustable crank arm *T*, Fig. 10, which adjustment does not affect the time inequality of stroke, but merely its length. The times of each half turn of the slot lever *c* are proportional to the arcs *P Q R* and *P M R*, Fig. 8, to which arcs, therefore, the times of the return and advance strokes are likewise proportional.

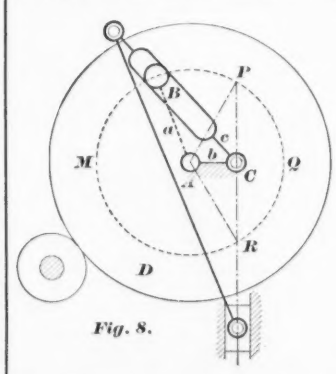


Fig. 8.

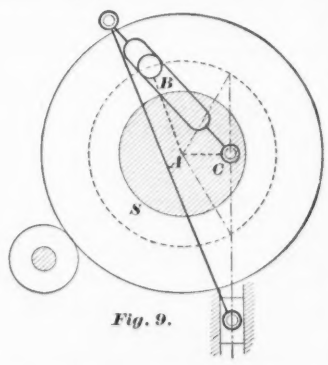


Fig. 9.

Such combinations as we have been considering are termed *kinematic chains* by Reuleaux. And it is apparent that, to form a mechanism, such a chain must be closed (of the nature of a closed polygon), and have one of its links fixed. Usually this fixed link constitutes the frame of the machine,

or is a stationary part attached to the frame, and the possibilities open up of forming as many different mechanisms from any one closed kinematic chain as that chain has links. Thus, fixing the link *c*, Fig. 4, gives the ordinary steam engine mechanism. This process of fixing a part formerly in motion is called *inversion*, and may be applied equally well to other trains of mechanism, such as gear wheels. Merely inverting the steam engine mechanism, fixing the connecting rod instead of its slotted (guide) link, gives at once the typical form of quick-return motion. Lengthening or shortening the links—expanding them in a line in the direction of their length—also give possibility of new forms, as may be seen by comparing Figs. 5, 6, 7. Adding to or taking from the number of links of a kinematic chain results in new typical forms at once, and these, likewise, may be worked through by inversion and linear expansion.

Mechanical equivalents, as two gear wheel combinations and cross-belted pulleys, may be easily obtained for almost any kinematic chain of mechanism, so that any given kind of motion may usually be transmitted by any one of several different kinds of mechanism, such as gear wheels, friction wheels, belted connection, worm wheels, cams, screw wheels, among purely mechanical means, and by hydraulic, pneumatic and electro-magnetic means among other possible ways. Of course in some of these the velocity ratio is constant, as by gear and worm wheels; while by others it is subject to some slight variations, as by friction wheels and belt transmission. After exhausting all of the possible ways of working the quick-return motion by means of link work, it will be found a useful exercise to devise other modes of connection for the same motion, such as gear wheels, cams, etc., and even an electro-magnetic quick-return motion is at once derived from a well-known electro-magnetic reciprocating running drill (Van Depoele). An interesting problem is the designing of mechanical (perhaps, better, kinematical) equivalents of the four-bar kinematic chain, Fig. 11, of the side-rod mechanism of the locomotive. Two are shown—Fig. 12 by belt, Fig. 13 by geared connection—the wheel *A* being fixed and the arm *X* rotated. For in this mechanism we have a straight line moved always parallel to itself, yet every point of the line describes a circle. If we consider this four-bar kinematic chain of itself, we find that it is possible for it to change into an entirely different mechanism, by the parallel rod becoming crossed, Fig. 14. This possibility occurs twice in each revolution of the cranks, and at the dead points, so that these same dead points in this mechanism become *change points*. If the crossed rod remains so—not changing back to its former parallel position—it will communicate a motion between the two cranks that is identical with the motion communicated by two elliptical spur wheels, Fig. 15. Mechanisms for multiplying motions, as from two vibrations of a crank arm, to obtain four, eight or more vibrations of another arm, may be extended to include those mechanisms by which two, four, eight or more reciprocations may be obtained from one rotation. The link work mechanism, forming the kinematic chain of the Atkinson Cycle gas engine, is an example of this multiplying of motions or reduplication (Willis). The so called "parallel motion" mechanisms offer a wide field for valuable study and research in the science of motions, and many of these systems of linkages may be replaced by their kinematical equivalents, in the form of gear wheel trains of mechanism.

However much has been left out of this very brief consideration of some of the elements in the invention of mechanism, enough has been presented to show that the growing science of applied kinematics has yet a wide field before it. Already many of the fundamental propositions have been enunciated, and the geometry of machinery, as in the geometry of Euclid, has its axioms, definitions and postulates. But this fact no more limits the field in the former case than it does in the latter. It is the working knowledge so necessary to substantial progress in any science—pure or applied—and the only sure foundation for lasting results, and the grander developments yet to come in the march of progress. The earnest beginner will soon find that he has left port without chart or compass, if he seeks to invent a combination of mechanisms to accomplish even the simplest mechanical movements, without starting, as in any other of the applied sciences, from fundamental conceptions and the simplest elements. A single trial of the common method will prove convincing, not to say disheartening and discouraging. And he is more than likely to throw the whole idea aside, as impossible of any development, at least in his hands, and with the common saying that "Inventors, like poets, are born, not made." On the other hand, it is entirely possible—as much so in applied kinematics as in applied mechanics—to logically develop the subject, so that the average student, at home or in industrial and technical schools, shall go through the course with added interest; also to find that he has come to have some power, at least, of analyzing new

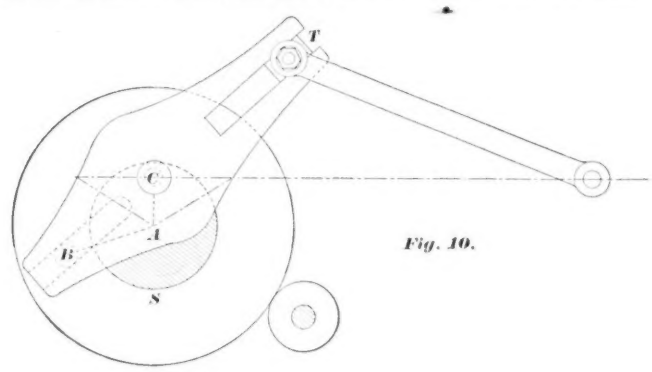


Fig. 10.

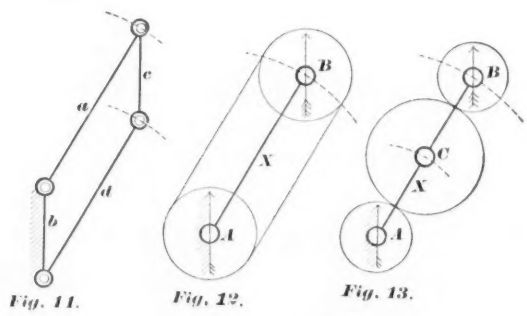


Fig. 11.

Fig. 12.

Fig. 13.

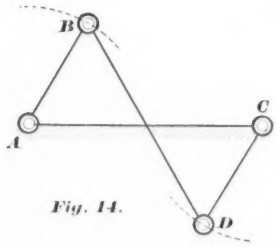


Fig. 14.

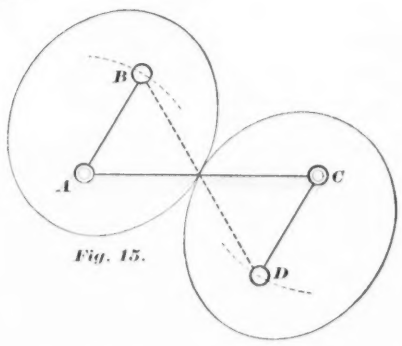


Fig. 15.

mechanisms, and of designing any of the ordinary mechanical movements that are likely to arise in his life work.

In regard to the introduction of this matter into our technical schools, it may be well for the founder of the modern science of the kinematics of machinery to speak. In the polytechnic schools of Germany, Russia and Italy, the Reuleaux methods have worked a considerable way, so that the students enjoy a regular systematic course of machine instruction, and are acquainted with its somewhat extended literature. In considering the extension of this work, Reuleaux states that it might appear at first sight the best plan to make a purely kinematical treatment of the subject a specialty—treating it by separate books and methods of instruction, and working through all the possible combinations, pair by pair, and chain by chain. Yet he does not consider this the best method; but, "It appears to me far more advisable that under 'Applied Kinematics' we should treat mechanisms, which might then be arranged according to their practical applications." The science of kinematics may solve the problem from the standpoint of pure motion, but it is the province of applied kinematics to envelop the ideal with material form and proportion adapted to practical applications. To have worked out, arranged and classified definitely planned motions, will be an indispensable aid in the solution of the machine problem; but modern constructive materials, processes and operations will govern the building up of the machine to do given work, accompanied by certain determinate motions. The kinematics of mechanism must be joined to the science of constructive mechanism to produce the best results.

Exercises in designing mechanical movements were suggested by Reuleaux, in connection with his own investigations in the kinematics of machinery. Though these elaborate investigations permitted kinematic problems to be given directly as exercises in any course of machine instruction, yet he did not wish to urge, then and there, the use of such exercises. Kennedy (who translated Reuleaux' work) would venture to go farther, and hope that such exercises might become both possible and popular among engineering students to a greater extent, even, than suggested by Reuleaux, and adds: "I know of no kind of exercises which are likely to excite so much interest among the class of young men who, in this country [England] devote themselves to the profession of engineering."

NOTE.—The following works of the authors referred to in these articles are out of print:

Willis.—Principles of Mechanism. London: Longmans, Green & Co., 1870.

Reuleaux.—The Kinematics of Machinery (translated by A. W. B. Kennedy). London: Macmillan & Co., 1876.

Some Press Work.

BY A. D. PENTZ.

There is a power to be coveted, and that is, of seeing more clearly into mechanics. If we could at once brush aside from a device to be studied, all that is false, useless, lame, or inoperative, it is certain that in many such cases the whole device would go, and to advantage, and it is as certain that in many such cases we would be further ahead if we were further behind. Because, if we were not educated to do a right thing a wrong way, by the circumstance that an art has grown in a false direction, we could, without the restraints of conservatism and our training in that art, consider the question in the light of our experience in the other arts, and the acquired knowledge we get from the experience of others in all mechanics. A few years ago, two old machinists who had risen from the work-bench to positions of responsibility, had in the course of their duties to agree on the best and cheapest way to produce certain pieces by the hundred thousand. One of these pieces was to be exactly a semicircle two and one half inches in diameter, and one-tenth of an inch thick. It was required that the edges should be smooth, the corners square, and that the outline should fill a gauge.

One of these men designed two milling fixtures and gangs of mills, to make first the straight diameter cut, and then the semi-circumference cut, from blanks to be punched about three one-hundredths of an inch larger than model all around. The milling fixtures were to hold fifty pieces each cut. The other man designed also to mill the straight side, but to turn in a lathe the circular part after it was clamped in an arbor, half of which should be cut away.

These two men not being able to agree on the best plan, the case came before the manager for a decision as to which of these ways the piece should be made. The man who wanted to mill the curved edge held that it could not be turned smooth by one cut, and if two cuts were needed the milling would be the cheaper. The advocate of the lathe held that considering the cost of the other man's fixtures, cutters, and the care of grinding them to cut exactly a true arc, there was no doubt that there could be three cuts taken on a lathe with the greater economy. But, however, he would guarantee to do it in one cut if the blanks were punched within one-hundredth of an inch of the model size all around the semicircle, but to have three one-hundredths on the straight part where it was to be milled. He held rightly, that his tools would cost but a trifle, and that one arbor would be filled while another was in use.

Now, two able and valuable men, both of whom know they are just right in their conclusions, can extract the sinecure feature from a manager's job, and make him earn his salary about as certainly as a device especially designed for that purpose. Hence, a press of other matters enforced an adjournment to give the manager time to study the situation. The head of the press-room was then conferred with, and after a satisfactory interview was smiled on and seen to the door of the room by the manager himself.

About one hour before quitting time (the press of affairs having slackened in the manager's room) the rival designers were sent for, seated, and addressed thus: "Now, gentlemen, we will continue the examination of that piece; but before we go any further, I wish to say that, after you went away this morning, I, having a few minutes to spare, thought the matter over from a standpoint differing considerably from either of those you advance. The scheme I would suggest is that the piece be punched one hundredth of an inch larger than model all around, and that it then be repunched to exact size, thus saving all the milling and all the turning. Now, to have this plan considered and compared with the two plans you have advanced, I will appoint the foreman of the press-room and both of you gentlemen a committee to decide this question, and shall expect you all to consider the interests of the factory whichever way you decide."

In a prior article, the writer touched on the operation of repunching for certain work, but wishes further to emphasize its economy, as it is known to have a great saving value, and the fact that it is not practiced to any great extent as a substitute for milling where it might be and should be, encourages him to repeat the suggestion, and hope that the process will be tried generally, and if tried, there is every reason to believe that money will be saved, and that more uniform and better

results will follow. It is found in practice best to repunch the reverse side up.

In the straightening or the flattening of sheet metal pieces, it is often quite a job to get them flat at a satisfactory cost. Few of the men whom it pays to employ on such operations have the judgment to draw the short parts of sheets at the proper spots, or even to strike them on the right side of the plate with a hammer. It does no good to squeeze them or strike them in presses, because elasticity enables the metal to spring to a plane under the blow, and quickly return to an undulating surface when the die is removed.

The solution of this problem was a matter of a good many dollars to a concern that once employed me. A great many good men had studied it, and very many experiments were tried; still the gang of men pounding at the side bench grew no fewer, and the gang of extra polishers who ground out the deep hammer marks rather increased. It seemed as if no saving could be effected.

At a consultation—a sort of last forlorn hope—the pressman made the remark that if "the blarsted things was all crooked alike, and it don't make any odds how much they are sprung, they could be dropped straight, I believe." But they were all shapes, some concave, some convex, and some had so many concavities, so many convexities, so many corrugations, and other kinds of distortions, that my vocabulary fails to describe them. So the pressman was reviled, and his idea was considered "no good." Still that idea solved the problem.

Among those present was one who ought to be a better mechanic than he is, considering his opportunities, and he would be a better one if he could forget the wrong ways of doing a great many things. This man, on his way to his headquarters, stopped short in his tracks in consequence of an idea having struck him. This idea seemed to him so obvious, that after a moment he started and ran back to the press-room, so as to get there before the rest of the gang should arrive with the remedy.

Now all there was to this remedy was to make these plates more crooked by a die than they could possibly be from the sheet, and thus make them all alike, and then straighten them by another die, which bent them back straight, and a little more to compensate for the spring in the metal. Some shaped pieces will straighten best with a cylindrical bend, and others with the spherical one.

It will be noticed that this is but the application of the wire straightener principle to the sheet, and that is what I mean when I say that we should know more if we didn't know so many things that are not so. If we, as machinists, had not been so intent on the conservative method of hammering flat a sheet or a saw to straighten it, and if we had but turned to the near-by art of wire straightening, in which all crooks are forced out of their various individualities into one great crook, and then that crook is straightened out by bending it back just so far, we should have made fewer blunders. When a man is able to drop how it "has been done," at the time he is about to calculate how it shall be done, he is a better mechanic than he previously was, when he had not that much knowledge.

Where pieces are made at the rate of fifty thousand a month, a very small item of cost or profit on each aggregates enormously as a total. One-tenth of one cent each comes to six hundred dollars a year. Hence, in lines where the competition is great, every fraction counts.

A certain piece of sheet metal about six inches long, and of irregular shape averaging more than one inch wide, and being about two-tenths of an inch thick (No. 7 wire gauge), was required to have a round shape on all the edges. There were a number of openings through it, and these also were to be round edged. Originally, these pieces were rounded on emery wheels, and the interiors were filed, but as the demand increased this became impractical, more on account of room than expense. But after a while a competition grew out of two of the workmen going out, starting for themselves, and underselling greatly. Then new methods were demanded; for two men working for themselves, with no expense except a small rent and power outlay, requiring no tools excepting one second-hand punching press, and an emery wheel frame, could compete very successfully with an elaborate concern that added a department expense of thirty per cent., and a factory expense and profit of fifty per cent. to the cost of everything made, regardless of the actual circumstances of its outfit of tools and their repairs, the power required to produce it, or the floor space it occupied in the making of it.

The rounding of a corner on both edges of a sheet steel piece under a press may seem a very easy thing to do, but when the comparison is to be made with the results from polishing wheels, it will be found necessary to try twice.

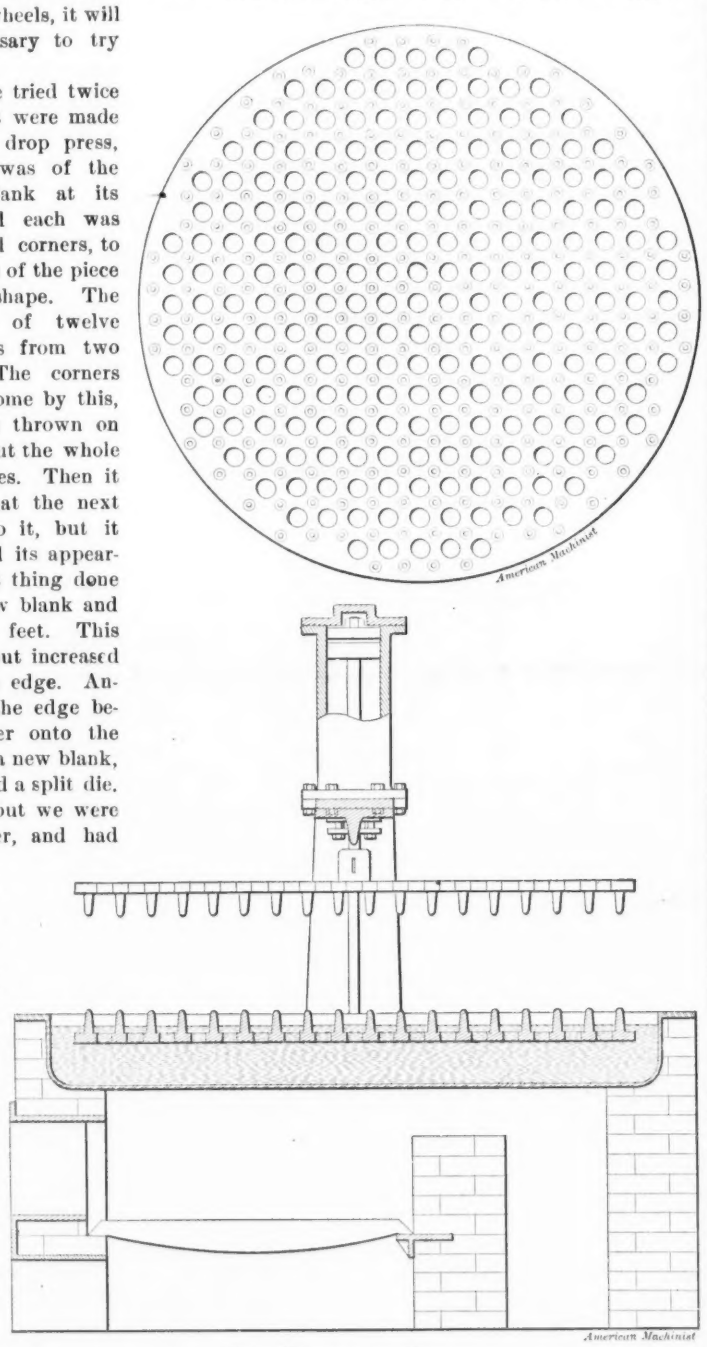
In this case we tried twice and more. First were made two dies for a drop press, each of which was of the shape of the blank at its outer edge, and each was sunk with round corners, to press the corners of the piece to the desired shape. The first blow was of twelve hundred pounds from two feet height. The corners were rounded some by this, but a ridge was thrown on the flat sides about the whole line of the edges. Then it was thought that the next blow would do it, but it scarcely changed its appearance. The next thing done was to take a new blank and drop from four feet. This rounded more, but increased the ridge to an edge. Another blow and the edge began to hem over onto the flat side. Then a new blank, six-foot drop, and a split die. We knew more, but we were two weeks older, and had spent fifty dollars for dies that were of no use, and had consumed much of the time of three or four men, two of whom drew good salaries. After that we made a new under-die, and tried a smaller blank; then there were three ridges, one on each face of the piece and on the edges.

The other experiments that were made were of the general character of those described, and were of no value whatever. Of course, some experience was gained which helped in the end.

After our guessing capacity had been exhausted, then we sat down and did what we should have done at first—considered the thing in the light of all we knew of everything that had any application to it. Where did we expect that corner to go to? We hadn't thought. We all knew, or thought we did, about the flow of metal, but we never applied flow to the question. Now when we thought of actually driving that fillet of metal into solid steel, we called each other donkeys all around. And the idea of upsetting the whole piece by a blow on its corners was simply ridiculous.

After an intelligent consideration of this question, it did not take long to determine that, while it could not be solved by forcing metal to flow into places already full, it would have to be solved by flowing it into a suitable opening of the required shape. With this in view, a considerably smaller and thicker blank was punched, and the edging die was made at its deepest part, the exact size of the blank. The corners outside the blank in the edging die were made the shape the piece should have when completed, so that when the piece was struck thinner it would flow outward, and be forced to take the shape that confined it. In the flat bottoms of the dies was cut a scroll design ostensibly for ornament, but in reality to accommodate the surface flow, and avoid the enlargement of the outline of the plane sides.

Thus, with soft annealed machinery steel, repunched to smooth the edges, satisfactory results were obtained.



SAW TEMPERING DEVICE.

The makers of engineering instruments have decided to make a collective exhibit at the World's Fair, and Mr. G. N. Sagmuller, of Fauth & Co., of Washington, has been authorized to receive applications for space, and make arrangements for the exhibit.

Saw Tempering Device.

BY GEO. L. FOWLER.

It is acknowledged, I believe, to be a rather difficult piece of work to heat evenly the large steel plate that is destined at the end of its manipulation to be a circular saw, even though a lead bath be used for the purpose of securing the required elevation of temperature. The trouble lies in the handling; for, unless the plate be taken out evenly, the part first removed will radiate a portion of its heat before the other part leaves the bath.

In order to overcome this difficulty, the machine illustrated was designed. By this, a plate six feet in diameter can be given a perfectly uniform temperature and evenly submerged in the bath of oil.

The lead is heated in a wrought-iron pan, set in the brickwork of a hard coal furnace. This pan was made of wrought-iron ¾ inch thick, and was flanged to a depth of about 9 inches—a very respectable piece of work, by the way, and one that every boiler maker would not care to undertake. In this lead bath there floats the cast iron disk as shown.

The disk is perforated with holes 2 inches diameter, and is studded with pins 3 inches long, rounded at the ends, and which float above the surface of the molten metal.

On an arch springing across the pan there is a cylinder 7 inches diameter, having a piston and rod as shown. The lower end of the piston rod is keyed to a disk identical with the one floating in the lead, except that it has a hub for keying to the rod, and the pins project downward. The piston is packed with hydraulic cup packing, and the rod by a stuffing box with gland. Oil under hydrostatic pressure is used for raising and lowering the piston, and this oil is supplied under pressure by an ordinary belt-driven power pump. A four-way cock admits oil to the bottom of the cylinder, permits it to exhaust through the same opening, or locks the liquid in, thus holding the piston in any desired position.

The method of working is exceedingly simple. The piston is pumped up to its upper position and locked. The disk in the bath then floats up so that its pins project slightly above the edge of the plate, capping the brickwork. The saw plate is pushed over and allowed to rest on the pins of the lower disk. This sinks the lower disk a trifle, but not enough to submerge the saw. The oil is, therefore, allowed to flow out of the cylinder until the upper disk pins have depressed the saw plate below the surface of the lead. When it is heated a reversal of the process raises it evenly from the bath.

For submerging in oil, a mechanism essentially the same is employed. The wrought-iron pan is replaced by one of cast-iron, and the floating properties of the molten lead are replaced by a number of springs beneath the lower disk that have the strength to raise the pins above the level of the pan.

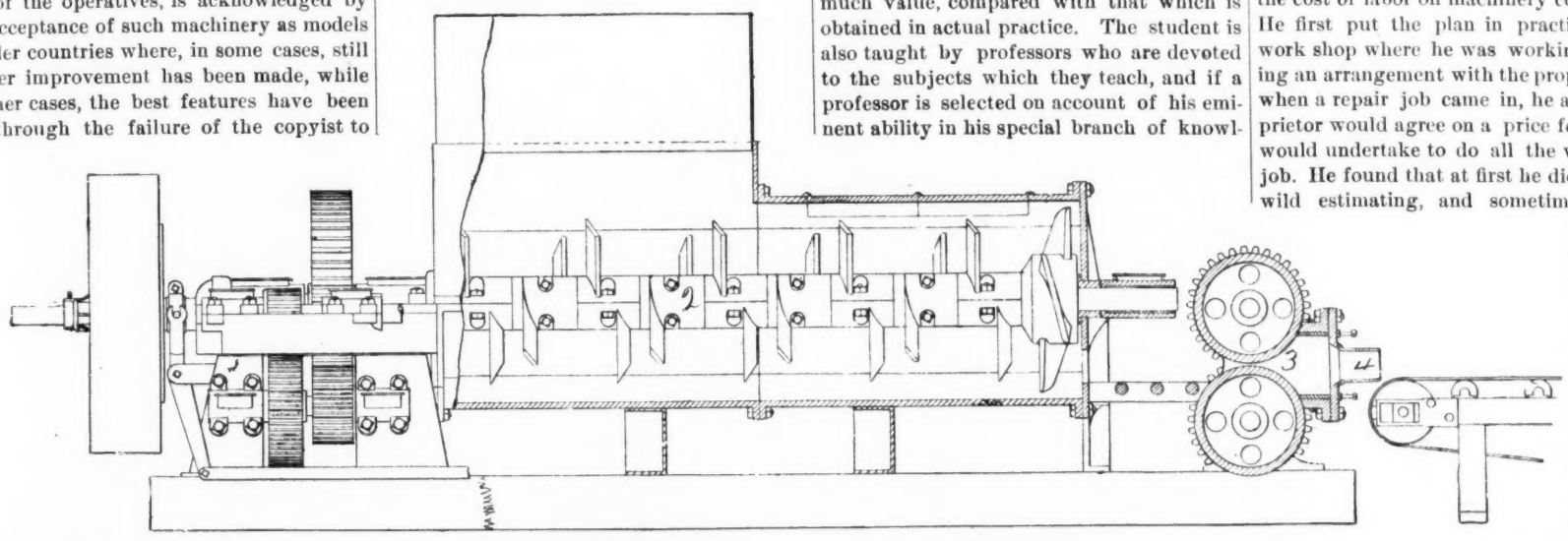
Thus the problem of absolutely even heating and cooling can be settled, and the annoyance of warping from unevenness in this regard entirely avoided.

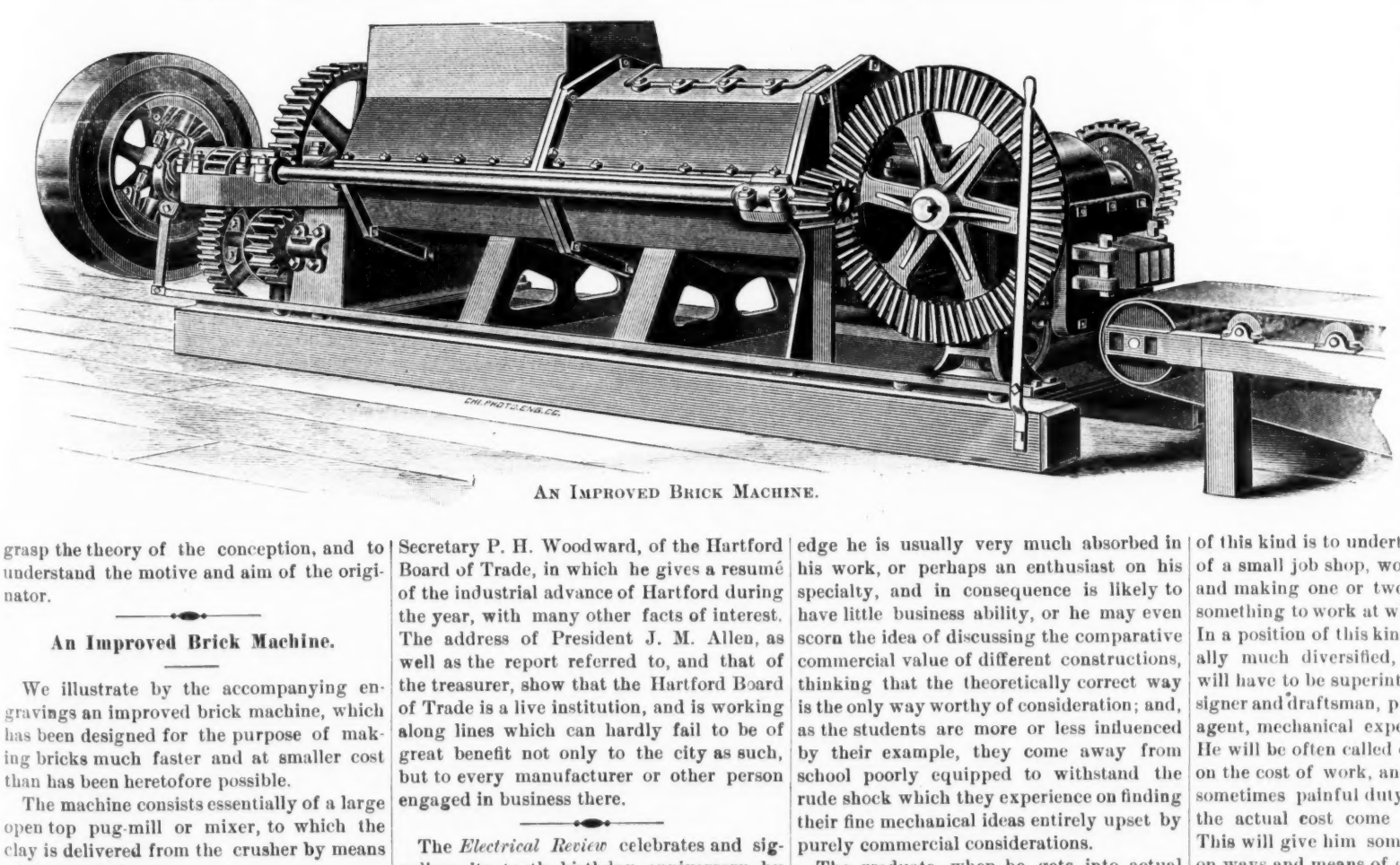
American Machinery.

Machinery (of London) has inaugurated a department of its journal called "Machinery in America," in which illustrations and descriptions of American machines are published, the letter derived mostly from our columns. In a recent issue it publishes the following:

Our various articles on "Machinery in America," a feature, which we are pleased to note, has met with great satisfaction on both sides of the Atlantic, has brought us a good deal of correspondence and inquiries as to the specialties we have noticed. But it is not alone in machinery that our cousins have made great headway, for, as an esteemed American contemporary recently pointed out, the progress of a nation can be very well followed by noting the character of the tools required in prosecuting the manual labor. The crudest agricultural methods are coupled with primitive ploughs and other instruments of the husbandman. There is an old saying that a good workman requires but few tools, and the most elaborate kit collected by a modern enthusiastic carpenter when beginning his trade may be no indication of the workman's skill; but, on the other hand, the workman who has added to his stock of implements new though simple aids, is apt to be the one who can do the best work the most rapidly. The United States is now recognized as particularly strong in the machine tool industry, not only in regard to the higher class of lathes, planers and boring machines, but in all the minor hand tools, measuring devices and graduated scales, and in the many productions that were but a few years

ago to be had only from importers, poor in quality and in design. The fundamental principles that underlie the theory of construction of machine tools have been studied by the American engineers, incited by the necessity of doing good work in large quantities through the instrumentality of only moderately skilled workmen whose wages are high. It would be invidious to point to any one man or any set of men as presumably the originators of what is theoretically good in the application of the laws of physics to the embodiment of these laws in labor-saving machinery, nor will space permit the explanation of how correct principles introduced little by little have been accepted by all, and thus in time become characteristic of best designs. That American machine tool makers have produced labor-saving machines capable of doing the best work with less skill on the part of the operatives, is acknowledged by the acceptance of such machinery as models in older countries where, in some cases, still greater improvement has been made, while in other cases, the best features have been lost through the failure of the copyist to grasp the theory of the conception, and to understand the motive and aim of the originator.





AN IMPROVED BRICK MACHINE.

An Improved Brick Machine.

We illustrate by the accompanying engravings an improved brick machine, which has been designed for the purpose of making bricks much faster and at smaller cost than has been heretofore possible.

The machine consists essentially of a large open top pug-mill or mixer, to which the clay is delivered from the crusher by means of the usual elevator.

The necessary amount of water is added to make the clay the proper consistency for forming or molding, which is done by means of a pair of turned rollers (3, Fig. 2) receiving the clay from this pug-mill, and forcing it through a series of dies (4) in columns onto a table, which automatically cuts these columns into brick lengths, separating them ready to bake in the drying cars.

The plan simplifies the making of brick by the "stiff clay process," dispensing with a number of superfluous mixing machines, elevators, etc. The various operations of grinding, mixing, molding and cutting are in plain view and under complete control. The advantages of the rollers for forcing the clay through the dies are: 1st. That a number of dies can be used at one time, molding several columns continuously, greatly increasing the output over that of single column deliveries. 2d. The brick are comparatively free from laminations, and are uniform in texture, overcoming the tendency to warp or crack in drying and burning, thus making a more solid wall.

This machine is now built in three sizes, of the following capacities respectively: 25,000 per 10 hours, 50,000 per 10 hours, 100,000 per 10 hours.

The arrangement of the gearing and the friction clutch, by which the motion of the machine is controlled by the operator from the delivery end, will be readily understood from an inspection of the engravings. The machine is made by the Decatur Leader Manufacturing Company, Decatur, Ill.

We have received the annual report of Secretary P. H. Woodward, of the Hartford Board of Trade, in which he gives a resumé of the industrial advance of Hartford during the year, with many other facts of interest. The address of President J. M. Allen, as well as the report referred to, and that of the treasurer, show that the Hartford Board of Trade is a live institution, and is working along lines which can hardly fail to be of great benefit not only to the city as such, but to every manufacturer or other person engaged in business there.

The *Electrical Review* celebrates and signalizes its tenth birthday anniversary by publishing a special number that is remarkable for its beauty, for the number and elegance of its illustrations, and for the vast amount of information given with regard to electrical matters. It is safe to say that most of those who are at all interested in electricity will want to preserve it for future reference.

Our esteemed contemporary, the *American Shipbuilder*, comes out this week with a new head-gear and dress, to emphasize its well-merited success. The design of the heading is certainly very pretty and appropriate for the character of the journal. The name is not printed quite as prominent as it might be, but this we suppose is due to the modesty of its editors and proprietors. The journal is only a little over a year old, but during this time the energy and ability displayed by its founders have secured for it a generous patronage and a reputation for reliability in all the latest and important marine news. We wish it as great success in the future as it has had in the past.

Development of a Mechanic.

BY BELL CRANK.

A common fault found in graduates of mechanical schools is their noticeable lack of business knowledge and qualifications.

The chief reason for this is that business methods have not yet been very successfully taught at colleges, and it is quite probable that it will never be possible to impart a business education at college that will be of much value, compared with that which is obtained in actual practice. The student is also taught by professors who are devoted to the subjects which they teach, and if a professor is selected on account of his eminent ability in his special branch of knowledge he is usually very much absorbed in his work, or perhaps an enthusiast on his specialty, and in consequence is likely to have little business ability, or he may even scorn the idea of discussing the comparative commercial value of different constructions, thinking that the theoretically correct way is the only way worthy of consideration; and, as the students are more or less influenced by their example, they come away from school poorly equipped to withstand the rude shock which they experience on finding their fine mechanical ideas entirely upset by purely commercial considerations.

The graduate, when he gets into actual practice, is too often prone to design elaborate and expensive details, which might be excellent and desirable, but are forbidden by rigid commercial conditions. There is not much sentiment in mechanical affairs; it is a cold-blooded consideration of dollars and cents. I do not wish it to be implied from this that the sole object of a mechanic is to make money and get rich, or that a mechanic is to be considered a failure if he does not accumulate money, for a man may be an eminently successful and useful mechanic and remain poor; but before he can be a success he must know enough of the business of building machinery, and selling it, to enable him to make money for other people. A mechanic without any business ability, no matter how accomplished he may be as a mechanic, will always be at a disadvantage, because he will be compelled to rely on other people for what he lacks in that respect, and the other people, being business people, will not fail to secure for themselves liberal pay for all they do, and he may content himself with what is left. It frequently happens that a man of only moderate mechanical ability, but with good business capacity, succeeds in getting all or a little more than his services are worth, by always taking advantage of every opportunity.

One of the most important things a mechanic may be called on to do is to make estimates on the cost of building machinery, and a few suggestions on this point may be desirable.

In conversation with a prominent mechanical engineer, he told me of a plan he early adopted to acquire experience in estimating the cost of labor on machinery construction. He first put the plan in practice in a job work shop where he was working, by making an arrangement with the proprietor that, when a repair job came in, he and the proprietor would agree on a price for which he would undertake to do all the work on the job. He found that at first he did some very wild estimating, and sometimes did not make fifty cents a day on a job, but he persisted until he learned to make very fair estimates, and found he could also make better wages in that way, and it was a more satisfactory way of working, as it seemed like doing business on his own account. He followed this practice wherever he could, and when he started in business for himself he continued the plan, always giving an estimate to his patrons on everything he proposed doing, and found it was the most satisfactory to his customers as well as himself.

Another way of getting experience of this kind is to undertake the management of a small job shop, working a dozen men, and making one or two specialties to have something to work at when job work is dull. In a position of this kind, the duties are usually much diversified, and the incumbent will have to be superintendent, foreman, designer and draftsman, purchasing and selling agent, mechanical expert and time keeper. He will be often called on to make estimates on the cost of work, and then will have the sometimes painful duty of striving to make the actual cost come within the estimate. This will give him some very good lessons on ways and means of getting out work at a moderate cost.

The most uncertain element in the cost of machinery is usually the cost of the labor, and much difference in the cost may be made in the designing, so the designer who has had practical experience in the actual making of machinery is the one who is most likely to produce designs of the greatest efficiency and least cost. The ability to estimate the cost of machinery is much more needed now than it ever was before, because there is very little machinery made at the present time without the cost being settled on before the order is given. The cost of the materials of construction is usually a simple matter to calculate, but the labor seldom is, and he who has special

ability in this way will find plenty of use for it.

Several of your correspondents had much to say about the born mechanics, but I failed to find any convincing evidence presented that proved that a man can never become a good workman unless he has shown convincing evidence of mechanical ability before his training was commenced. It was stated by one correspondent who had experience, that when a boy applied to him to be taught a trade he always made it a point to see if the applicant had ever displayed any mechanical ability in his boyish pursuits, and he then judged his suitability by such evidence. He claims to have never failed in his prognostication of such cases, and I will grant that it may be true, but he was certainly more fortunate than any person I ever met or heard of before. There are several well authenticated historical instances where men, who afterward became noted for special ability, were in their youth dull and slow to learn, and did not show any promise of extraordinary ability. It is so in regard to mechanics, and I think it a mistake for any one to be so cock-sure that he can tell if a youth has promise of mechanical ability, in every instance, for it is likely to result in injustice sometimes.

I knew of a boy who came direct from a farm, where he had been all his life, into a machine shop, and he was one of the most awkward and unpromising fellows I have ever seen, and every one predicted he would never be a good machinist. He was continually spoiling work and having accidents, and he seemed to have great success in finding the wrong way to do his work, but just by sheer persistence he finally became a good workman, and for quality and quantity of work he now exceeds many others who seemed more promising than he did. I question if he could have taken up any other vocation where he could have succeeded any better. It would have been an injustice to this man for any one to have decided his fitness for the trade by what he had done before he started at it.

I will conclude the subject by saying that no youth need be discouraged from trying to get a mechanical training just because he has not shown signs of distinct ability in that direction, or because some one has said he is not fitted for it; for such is the adaptability of human powers to the circumstances, that by persistence and industry, success may be wrested from very unpromising conditions. It is also true that the greatest mechanics will be born with a distinct ability for it, but there will always be plenty of useful work for those of trained ability, which genuis has not time to do.

LETTERS FROM PRACTICAL MEN.

A Rig for Boring an Eccentric Hole.

Editor American Machinist:

That this is an old idea I know very well, but there are many machinists who never saw it, so I think it is worth showing in the AMERICAN MACHINIST.

When we have our work bolted to the face-plate of a lathe, and at one setting bore a central hole and an eccentric hole with this rig, we are sure of the holes being parallel with each other; it is hard to be quite so sure in any other way.

In the sketch, *A* is the work bolted to the face-plate. *B* is the boring bar which is supported by the flat straps *C C*, which (straps) are bolted to the lathe tool-block, as shown. The power to turn this bar is supposed to come straight from the shoulder of the man in charge, and I have found it worked best with only one *crank*.

This rig, as will be understood, will bore just as many holes as are wanted at one setting, and all will be bound to come parallel with each other (using the common feed of carriage) which does not depend at all upon the bar being parallel with ways of lathe, only near enough to bore the hole closely enough to round.

It will be understood that if this bar is much out of line with ways of lathe, that the hole will be bored oval in shape instead of round.

I remember in the shop where I saw this rig used, they got a new, large lathe (about eight feet swing), for which they made a special rig of this kind, which would do good work and use the shop's power.

I remember pretty well about this, because I had a hand at making it and in trying it first.

The lathe tool-post was provided with four studs and two straps, as most very large lathes and large planers are.

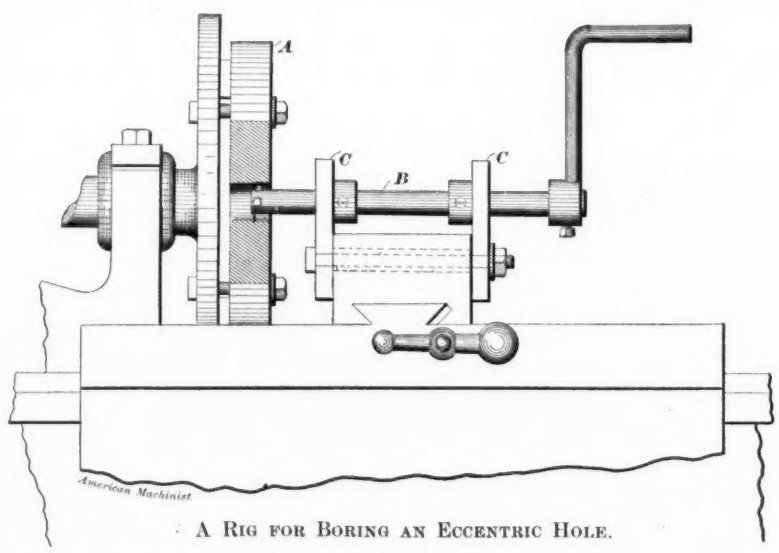
There was room for a bar 5" square under straps and between studs.

They made a cast-iron box or shoe about 2' long to be held on this tool-post, the same as the ordinary bars which supported the boring bar at each end inside.

There was a large spur gear on the back end of boring bar, or where the crank is on the one shown, which was driven by a small pinion, which (pinion) was fast to the driving pulley, both of which ran loose on a stud screwed into a lug on back end of shoe.

This pulley was driven from a long drum overhead. The feed we connected to the free running cone on spindle, so as to drive the feed screw without turning the spindle. This rig, as will be understood, would bore a hole automatically.

When we got this rig done, I was trying it by boring into an old car-wheel that I had bolted to the face-plate, when a molder from the foundry who was going by, saw what he thought was a new and interesting scheme, so stopped to look at it. He remarked that I had a "first-rate rig for boring car-wheels there." I did not know it, so asked what made him think so. "Why, don't you see? You can have a man stand here and put wheels on this side of face-plate; you can stand where you are and bore them when they come around, and then you can have a man stand between and take them off, and in that way keep one in the air all the time." I told him that it looked to me as though this way would be a little *too* quick. A MECHANIC.



A RIG FOR BORING AN ECCENTRIC HOLE.

Hubs and Bosses on Patterns.

Editor American Machinist:

In your issue of the 25th February, Mr. John M. Richardson's experience in making hubs or bosses for patterns, as given, may be favorable to him and some others in the pattern making business, but as a practical pattern maker I could not favor his system of sawing hubs in halves from the lathe. Hubs of a small diameter would be very tiresome to hold under the operation of sawing, and no matter how fine the saw may be, a hub of $\frac{3}{8}$" diameter would positively be an ellipse more than a circle. I should think the sawing would take $\frac{1}{32}$" of stock or more away, and would spoil the neatness of the pattern, and the inaccuracy would show very plain. The cost of the hack saw would not be counted with pattern makers, if the results would pay for the trouble. No mechanic wants his tool chest filled with tools unless they give good result in their operation.

I will try to explain my system or practice in hub making. The first operation is to decide the grain you want your hubs to run, get stock out in halves 2" longer than necessary, and face to a good joint, glue the 2" at one end, or spare stock together; when dry, screw on screw chuck so the joint will be dead central, turn full length to size of fillet, set your dividers to the radius and line out; turn out fillet to diameter, cut off with sharp tool, and the halves, perfect, will be finished in the same time as you will turn your unsawn hubs.

If a practical pattern maker can tell me of a better and simpler or more accurate method, I shall be ready to adopt it with pleasure. H. COOPER.

[Mr. Richardson stated that he used very thin saws, and took out not over .02", and it is therefore not in order to base criticisms upon taking out $\frac{1}{32}$". Nevertheless, we are glad to publish Mr. Cooper's method.—ED.]

A Mechanical Engineer's Pocket-book.

Editor American Machinist:

I believe there would be a ready sale for a book about 5"x2½"x¼" that could be carried in the vest pocket, containing such rules, tables, and abridged information as would apply to the average machine, pattern, foundry, blacksmith and boiler shops. It would not need to tell how much corn it would take to fatten a hog, nor how much grain to sow to the acre, or even who the last presidential electors were.

I think some of your valued contributors could assemble some such information as has been designated above that would meet with a hearty approval from thousands of our mechanics.

Appreciating your efforts as publishers of so excellent a paper, I have the pleasure to remain, T. D. DELAND.

[Most of the pocket-books in common use have been intended to cover pretty much the whole field of engineering—some of them still more than this. The result is that they nearly all contain a good deal that is of little or no use to the mechanical engineer, though several of them are excellent intrinsically. There is a growing conviction that there is a demand for a pocket-book devoted exclusively to mechanical engineering and machinery, and one has lately been published (noticed in our issue of last week); we know of another which is in course of preparation by an American engineer.—ED.]

Printing Press Cylinders.

Editor American Machinist:

I am not much of a writer, but I have been so interested in what has appeared in your columns on making printing-press cylinders, that I thought I could write something about them, because we cast on an average for one firm alone 25 cylinders a month; we have made them in many ways, but after a good deal of experience we prefer to mold them on the side in 2 flasks, and then turn them up on end. We use patterns and core boxes similar to that Mr. Dingey shows but not exactly; there are more arms and heavier in the ones we make. We do not cast the extra length for cutting off the same shape as Mr. Dingey shows, we cast them both with cast iron shaft and for steel shaft, but these items have more to do with the design than the casting. I know of foundries where they make these cylinders like Mr. Brand shows, but it is not the quickest way. I could ram up a cylinder in about half the time on its side than on end. It takes one man two and one-half hours to ram up a press cylinder five feet long, 14" diameter, and finish mold, and an ordinary core maker three hours to make the core. I don't think Mr. Brand could get any molder to make such good time as that with making the cores in pieces and running the mold up on end. According to Mr. Brand's statement, any second-class molder or even an apprentice boy can make press cylinders after his plan. I beg to differ with him; he has been misinformed. I hope I shall not get in hot water with Messrs. Dingey and Brand, but I thought that these few remarks might be of some interest to your readers.

T. A. CUMMINGS.

Reaming Tool Steel.

Editor American Machinist:

If A. Sangster will use a solid fluted chucking reamer which he can buy or make (if he has the facilities for grinding after the reamer is hardened, if he has not, would advise him to buy one) use lard oil, and if reamer does not make a smooth hole, he will find that two or three of the flutes do all the cutting. Should this be the case, rub them down with an oilstone, and be careful to keep the clearance right. Many machinists believe a chucking reamer made by a reliable manufacturer will always ream a smooth, true hole. This is not so. When reaming tool steel, I invariably have to rub down some of the cutting ends of the flutes.

K.

Accurate Turning to Size.

Editor American Machinist:

Mr. L. C. Sharp's letter on the subject of shaft turning gave me much pleasure, for I had begun to think that the light manner of my inquiry had served to hide its really serious intention. While Mr. Sharp's points are very interesting and valuable, I should like to hear from him and from others in answer to the chief question of my former letter, which now I shall put again, but in a clearer form: How can we turn accurately and quickly without using a file? Given a shaft, say from two to five inches in diameter, to be turned straight and true, so that a bush say eight inches long can be slid over its entire length easily, but without shake; how can this be accomplished without using a file? Every lathe hand that I have ever known would turn the shaft (or the journal, for this method is the same for all lathe work) to about the required size, and the last fitting would be done by filing. Now, why is the file used at all? Is the lathe of necessity an inaccurate tool? No one thinks of following this method in nice and accurate planing; and a machinist who would plane a job to *about* the size, and then would begin to file it to fit his template, would find himself enjoying the fresh air outside of the shop in a very short space of time.

For myself, I think that it is quite as incorrect and wasteful of time to use a file on the lathe as it is to use it on the planer, and that work can be turned far more accurately and much quicker without touching it with a file; and I invite the views of your readers on this subject, after giving some conclusions which I have reached. One reason for the general use of the file may be found in the inaccuracy of the lathe as made by nearly all builders. The lathe, in turning, gives its own inaccuracy to the shaft or journal. Another reason is that, for accurate turning, even when the lathe is true, a good rest is needed to keep the work to the tool; and the following or leading rest seems to have received no attention from lathe builders. Is there one lathe manufacturer who furnishes a good rest with the lathe? Taper turning attachments and pulley turning rests are used *sometimes*—once in the lifetime of a lathe, and these it is the "fad" to furnish, "without extra cost"; but good, well designed rests cannot be had, except you make them yourself. Most of the rests made by the lathe builders are utterly useless, and all of them, so far as I know, bear

little evidence of design; they seem to be creatures of chance, and to have made themselves.

I hope, then, that your readers will send a few sketches for good, practical rests for the lathe, and discuss more fully the methods of and means for accurate and rapid turning, without the use of a file.

"PASSAIC."

The Mossback Mfg. Co.

Editor American Machinist:

In reading the notes from various machine shops around the country, which your enterprising young man picks up, I don't remember ever seeing anything from the Mossback Mfg. Co. Yet this is a large concern, engaged for many years in building machinery, and uses some very unique methods of doing business, both in shops and office.

You may remember that during the "late unpleasantness," the expression "How not to do it" became a familiar one. This is our policy at Mossback, and I do believe if by some upheaval of nature we should be put in train to do business on real business principles, we should all die before we got used to it. We do things because they always did them that way ever since the works started, and of course we cannot change. What matter if we can't keep up with the procession, and have to see customers dropping off and getting their machinery elsewhere? We stand for the grand old Mossback principles, and would far rather go under than abate one jot of the fossilism which has kept our stock below par for so many glorious years.

The chief arbiter of our destinies is our treasurer, Mr. Moneybag. His headquarters are not here at the works, where you would naturally suppose them to be, but in a distant city. He was chosen by the board of misdirectors, not because he knew anything about the business—for he doesn't—but because his father used to be treasurer years ago. This you must admit to be the greatest reason in the world. He has a good business of his own, draws a fat salary as treasurer of the Mossback Co., besides the doubling of that in commissions on supplies purchased during the year for the company. But he is a real nice man, and when he comes down to Mossback once a week, for a couple of hours, his benevolent countenance as he crosses the yard is a sight full of comfort.

Not long since, the Hugag Mills, a newly formed concern, were in the market to buy machinery. They invited us to send proposals, and offered to pay part cash and part in stock of the new company. But Mr. Moneybag, not finding that our company had ever done business that way, couldn't accept the terms, although the out look was good and security of the best. So the job went to one of our competitors, the Progress Machine Shop, which was glad enough to get it at the terms proposed. They made the machinery, got the pay, put the stock in their safe, and waited. Hardly had the raw material got through the Hugag Mills, when their stock was in demand at a nice little premium; so the Progress sold the stock they held, and were in pocket by the operation, beside their profits on the machinery, with the certainty of having the inside track whenever the Hugag doubles its plant and wants more machinery. Some of us at Mossback felt sore over this, for work was getting a little dull; but we consoled ourselves with the thought that the old concern was true to its principles, after all.

Such a man as our treasurer is the watch dog of any concern. Suppose the superintendent should break out in a new spot, and want some new tools to replace those which were used as ballast for Noah's Ark, there should be some one to ask why *he* must want new tools, when we have run those lathes ever since the works started. This is usually a crusher; but should the matter be pressed, the remark that the old lathes can't be any worse than they were yesterday, or last week, or a month ago, will end the conference for that time. The misdirectors want dividends, and can't afford to buy new tools.

In my next, we may look up some shop and foundry matters. P. AUGER.

Hardening and Tempering Steel.

Editor American Machinist:

In the AMERICAN MACHINIST of February 25th appears a letter signed "A Mechanic."

He says he "knows of nothing about which there are so many vague ideas as on steel hardening;" he also says, "If you ask a blacksmith about it he will give you a knowing look."

There are some blacksmiths of that kind, but it is seldom they know much about it. My grandfather, my father, and, I might have said, my great grandfather were old-time blacksmiths. I also am an old-timer, having worked at the trade for nearly fifty years, and am still working at it, and do not know of anything necessary for working steel but knowledge and experience coupled with the proper equipment and articles.

My experience has shown me that nearly all the art of tempering is to know the temper of your steel before it is tempered, and the things to use to bring about certain results. The balance of the art is in difference of form, and in knowing the difficulties to be contended with in such and such cases. My grandfather was celebrated for tempering mill picks; he used to say he did not care who knew what he used in the water, but that "all the art laid between him and the anvil." By that he meant to say that in working the steel he knew more of qualities, and consequently how to heat it to harden properly.

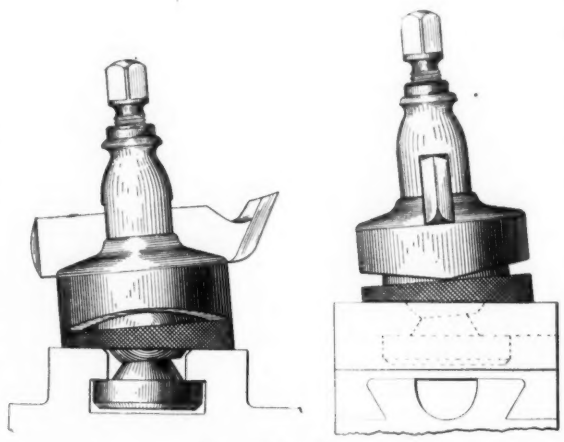
Now some of the important points are that if your steel will not harden at the proper heat (which should never raise a scale), then something should be done so that it will; and to help it to do so, mix with the water one pint of sulphuric acid and one pound of salt to one gallon of rain water. You may also add one ounce of bichloride of mercury to each gallon and stir before using; for some things, a small quantity of salt will be sufficient. A strong solution of cyanide of potassium will harden soft machinery steel on the outside as hard as glass, but will not affect the inside. In that solution I have hardened a thin point of soft steel so it would cut glass.

Nearly all the trouble of reamers and taps bending by tempering may be avoided by taking the piece of steel of which the tool is to be made, making it hot the whole of its length, cooling it in water, then annealing it, and without straightening make the tool. By careful tempering afterward it will not be very crooked.

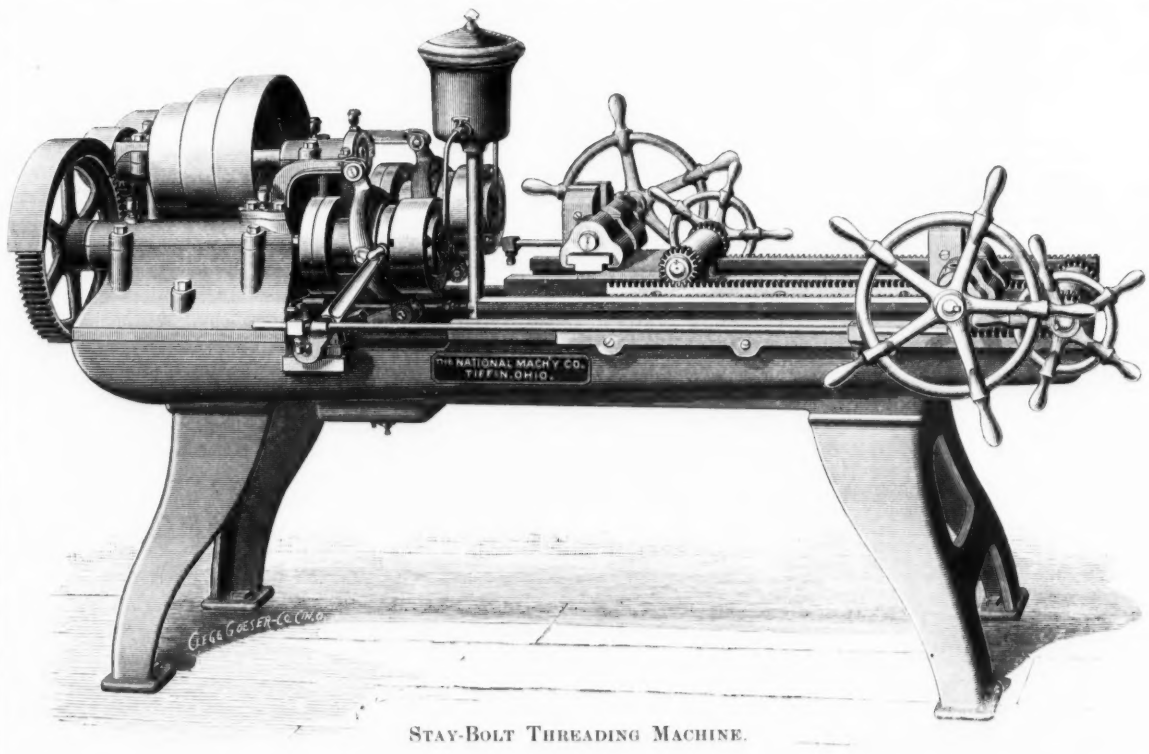
One of the best ways of tempering reamers is to have two vessels, one filled with water or the above mixture, the other filled with oil; hold in the water until the outside is cooled, you will be able to tell with a little experience by the vibrations running through the tongs; then lift out of the water as quickly as possible, drop it into the oil and allow it to remain until cold or until the oil and the steel are the same temperature throughout. Until then, steel should not be taken from either oil or water.

Steel, in most cases, becomes fractured by too sudden cooling rather than by too sudden heating; both are bad, but the former the worst of the two; the contraction on the out side is too great for the strength of the steel, because the interior heat prevents the center from diminishing in the same ratio; and again, if the tool have a large surface at its end, as a large reamer, it should never be held vertically in the water, because the heat at the end will form a steam space and prevent a circulation at that point, so that the reamer is likely to crack from the bottom upward.

For that reason tanks for cooling large steel tools should have a supply pipe at the bottom, which should always be turned on when the tool is put in. H. KNIGHT.



NEW TOOL-POST.



STAY-BOLT THREADING MACHINE.

Lathe Tool-post.

The accompanying engravings show a tool-post for lathe and similar tools, which is so made that the tool can easily be inclined in any desired direction either to secure the proper cutting action, rake, etc., or to enable a screw thread of any pitch to be cut either right or left hand by setting the tool at the proper inclination. The engravings give two views of the post, from which its construction will, we think, be readily understood It consists essentially of a stud which fits into the T slot in the rest in the usual way, this stud terminating at the top in a ball about which the recessed lower end of the post proper is so closed as to make a ball and socket joint which allows the post to be inclined in any desired direction. Then the collar upon which the tool rests is made double, the two parts fitting together upon spherical surfaces, so that this can also be placed at any desired angle. The flange of the lower portion of the collar has an inclined upper surface as shown, upon which the upper collar rests upon two points diametrically opposite each other. The result is a very neat tool-post which holds the tool securely and which can be set at any desired angle before tightening the screw, and tightening the screw binds the whole firmly together. The post has recently been patented by Mr. Anson G. Ronan, Toronto, Canada.

Stay-Bolt Threading Machine.

The importance of exact and close-fitting threads on stay-bolts is being daily more clearly recognized in locomotive and boiler shops, and in consequence the solid die is, in many cases, being abandoned for the adjustable opening die, which does not spoil the thread backing off, is speedier, and can be adjusted to make a tight fit to any size tap, following its wear if necessary.

Our illustration shows one of the latest designed tools adapted to cut stay-bolts three feet or under at one setting, and yet so compact that the operator can handle the vises on short work from any position, thus making it suitable for bolt work also.

The "National" head on this machine is so well known to our readers as to require no explanation, and the cut fully illustrates the points above mentioned.

The National Machinery Co., Tiffin, O., makers of this tool, furnish also when desired a nicker attachment to mark in advance the different lengths the three-foot bar may be wanted cut into when finished.

The dies open automatically at any desired point. When preferred, the machine is furnished with a single head instead of double as shown.

The articles by Mr. Leicester Allen, on the Cultivation of the Inventive Faculties, are proving to be very popular, and many of our readers are sending in solutions of the last problem, given in our issue of February 11. Of course, it should be recognized that the principal benefit to be derived from an attempt at a solution is in the practice it gives, and the increased mental power to attack and solve other problems. Mr. Allen will probably soon be ready to publish some of the latest solutions, and to present a new problem. No one, who wishes to improve in that respect, should fail to work out a solution, send it in, and compare it with others. The practice and experience so gained can hardly fail to be of great use in some way to any one who has to do with machinery.

We have received the catalogue of the Ohio State University for 1891–'2. The university is well equipped for teaching mechanical engineering, Prof. S. W. Robinson being at the head of this department.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
96 FULTON ST., NEW YORK.

PUBLISHED WEEKLY AT
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

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$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
DEALERS SUPPLIED BY

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The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne,

NEW YORK, MARCH 10, 1892.

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Responsibility Without Control.

One of the curious manifestations of human nature which often proves very annoying to the mechanic is that which is shown by proprietors of machine shops and factories who, knowing that things are not going right in the manufacturing part of their business, look about for the best man they can find or whom they think they can afford to employ to take charge of it, and then when he is installed refuse to allow him to do what his judgment and experience tell him is necessary to be done in order to put the plant in good working condition.

Scarcely one of these proprietors would think of requiring a lawyer to explain to him the detail and the exact reason for every thing done in the conduct of a case, much less of hampering him with detailed orders as to how to conduct it, what to do, and what not to do at every step. A lawyer would be selected on the ground of his supposed ability to conduct the case, and then its management would be left to him. The same would be true in the case of a physician, and yet the man who would never think of treating a member of either of these professions in any but a proper and fair way, will employ a mechanic or mechanical engineer to conduct his factory and to improve its efficiency, and immediately begin to hamper him, to impose absurd and unreasonable conditions upon him, and, in short, to make it utterly impossible for the man to perform the service for which he was hired.

Such men seem to be so constituted as to be unable to perceive that the superintendent of a manufacturing plant, for instance, who is successful as such, must be a man of brains, and that he must not only possess the brains but that he must use them; and, not being allowed to use them in such a way as to apply the results of his experience and study of the business, it is utterly unreasonable to hold him in the least responsible for results. No man should be held responsible for that which he cannot control.

Not long since a young mechanic of our acquaintance left a good position to take charge of a shop employing about forty men on electrical work. The proprietor, in this instance, was an educated man and an electrician, but knew nothing of shop practice. He himself was not as fully aware of this latter fact as he might have been, and had been trying to run his shop himself. He found his work was costing too much and hired our friend to make it cost less. Our friend had previously looked through the shop—had seen how things were being done and knew he could greatly improve upon the methods. He was no more than fairly installed before he found himself hampered, restricted and upbraided for not immediately—during the first week of his service, materially lowering the cost of the work. In vain he pleaded to be let alone for a month or two and to be allowed to make such changes as seemed best to him during that time, then to be judged by the results—the only thing for him to do was to resign.

Another case was that of the inventor of a well known type-writing machine. As president of the company manufacturing it, he directed the manufacturing plant and had under him at different times several nominal superintendents, finally engaging a man well posted in manufacturing operations and with a good record as a manager and mechanical engineer. This man went to work to correct the most glaring faults first and in detail. When he had made a study of a particular point, and made up his mind as to the best method of improving it, he would present the matter with his plans to the proprietor only to be told that there was "no use in going into that, we have been all through that and found that nothing can be done for the improvement of that process. You had better devote your time to something of more use."

When this experience had been repeated several times, and our friend had been allowed to do practically nothing for the improvement of the plant, he resigned, to seek a position in which he would be allowed to do the work for which he had trained himself. In this case no fault was found, but of course it would have been simply a matter of a short time before fault would have been found with him for not doing what he was not allowed to do.

Neither of these employers had had any shop training whatever, and could not reasonably expect to manage their shops successfully. They seemed to know this much and enough more to cause them to seek out good practical men to take charge of the shops. But having got them, they treated them as though they thought them unfit to be trusted with the work they were hired to do, and thus effectually defeated the object sought in engaging them.

Such instances are continually occurring, and we suppose will continue to occur, but mechanics cannot be too careful in taking new positions that they do not find themselves tied hand and foot by the very man who ought to be most interested in giving them every possible opportunity to make improvements. Investigations on this point previous to engagement, cannot be too carefully made, nor can the conditions be too explicitly stated or too clearly understood. Mere "glittering generalities" as to the plain necessity of a new man, and of willingness to "back you up," "let you have full swing," etc., often prove very delusive.

It often happens that for some reason a proprietor wishes to retain the management of his shop in his own hands, and to have others merely carry out his orders, but where this is the case such a proprietor should be honest with himself and with others, and let it be understood that others are not entrusted with responsibility nor paid for bearing it.

Good men who are seeking positions of responsibility will then waste no time trying to work for such employers.

As to Standard Gauges.

In our issue of February 18th, we published a letter referring to the writer's experience with gauges. It amounted to rather a severe criticism of the commonly used standard gauges, but we believed it to be honest criticism, and perhaps representative of others opinions upon the same matter, and as we knew there was very much to be said on the other side, so much that any discussion of the subject in our columns could only result in additional credit to the admirable work of American makers of standard gauges and tools of precision, we admitted it, even though the comparatively small number of manufacturers engaged in this line made the communication seem almost objectionably personal.

To any one who is in touch with the work being done in this line in this country, the wonder is, not that micrometers and other gauges are not more accurate, but that they can be made so nearly perfect as they are, and still be sold at a price which puts them within reach of the tool makers who are to use them. For it is to be remembered that the average tool maker cannot afford to pay the price which would necessarily have to be charged for a scientific instrument of precision, and for his every-day work such an instrument would be utterly useless to him, even if he should purchase it, for it would be far too delicate, and its use much too troublesome and tedious. No degree of refinement is admissible which puts the tools out of reach of the workman, because to be of any service such tools must be liberally used, and he who undertakes to make a micrometer caliper, for instance, with a limit of error of .00005", will find that when it is finished he will have to charge far more for it than micrometers good enough for all practical purposes cost at present, and moreover would, unless some special and expensive means were adopted to eliminate the "personal equation," find himself overwhelmed with disputes as to the limit of error actually attained.

The micrometer calipers now in use, as shown in the lecture referred to by Mr. Heckendorn, and also by the experience of many other mechanics, are in most cases within the limit of error of .0001" to .0002", and so far as we are aware, the field is entirely open for those who wish to produce calipers with a smaller limit of error, and furnish them at prices which will admit of their being generally used.

Much the same may be said of plug and ring, as well as other forms of gauges. It is our opinion, based upon considerable practical experience with and observation of those furnished by makers, that they are now fully equal to all that is claimed for them. It is to be remembered in this connection that no maker of gauges can be held responsible for their condition for any length of time after they leave his hands. When it comes to really close work, a surprisingly small amount of wear makes a perceptible difference in a gauge, and gauge makers have not yet been able to eliminate this difficulty, and probably never will.

Additions of smaller gauges and comparison of them with a single gauge nominally equal to them, we do not consider fair to the gauge maker, except to demonstrate whether or not a specified limit of error is exceeded. No maker pretends to make perfect gauges, and such a test would require that they should be perfect, or at least so nearly so that their cost would be prohibitive.

No one can possibly know for himself whether a certain gauge is within the limit of $\frac{1}{20000}$", unless he is equipped with the necessary apparatus for certainly determining magnitudes of that character, and in the absence of these, the guarantee of a reliable firm, and especially one which makes public its method of determining such magnitudes, is the best assurance we know of.

There is another point to be considered, and that is the influence of the strains set up in the steel of which a gauge is made in hardening it. It is only within the last few years, when gauges have been made within very minute limits of accuracy, that it was discovered that gauges changed in size slightly for about a year after being hardened, and to get over this difficulty they are now finished nearly to size, and laid by for a year before final finishing. Gauges made before this discovery, and believed by all concerned to be correct, may now be found to be incorrect, especially near the ends at which the greatest change seems to take place. The Brown & Sharpe Manufacturing Company have found since they have gone into the making of surface plates for the market, that a similar action takes place with these, and that after being finished and laid aside for a time, they usually require some further correction before shipment, the strains which cause the changes in this case being, of course, caused by unequal cooling in the mold.

We think, to sum it all up, that he who has time and opportunity to investigate fully just what has been and is being done in the line of precision gauges and measuring devices—the difficulties which have presented themselves, and in many cases been overcome by persistent effort, will be convinced that the art of machine construction owes very much to the men who have interested themselves in the matter, and they are, to say the least of it, not exacting more than a fair remuneration for their work.

Literary Notes.

We have received a copy of the new edition of "Grant's Gear Book" for 1892. While this is a catalogue of the Lexington Gear Works, of Lexington, Mass., it is also much more than that, for it will be found a very complete and convenient hand-book on gears, for use in the shop. We perhaps cannot do better than quote from a letter of its author, Mr. Geo. B. Grant, who is well known to our readers; prefacing this with the statement that an examination of the book leads us to fully indorse what he says of it.

"I have decided to charge a small price for it, not to business concerns, but to the multitude of catalogue collectors and postal-card fiends who stand ready to take anything and everything that can be got for the

asking, and in whom there is not a suspicion of a possibility of business. I think the merely curious should be made to pay at least the cost of gratifying their curiosity, and so I ask fifteen cents from all but business concerns.

"To make the book worth this price, and well worth it, I have made it a brief treatise on gearing, covering the really essential points required for shop use. I have given rules for laying out and drafting spur, bevel, and elliptic gears, with fine engravings showing and having all the parts. I have included a complete odontograph by which any standard gear tooth may be drawn, a better article of its kind than many that are sold for from one to three dollars. The tooth plates show the actual sizes of all standard teeth from the largest to the smallest in actual use. There are 50 pages and 63 engravings, stiff covers."

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(88) A. N. W., Shippensburg, Pa., writes: Please give me a practical plan of testing the actual H. P. of an engine by means of a friction brake, without the use of an indicator. *A.*—See description and illustration of the Prony brake in our issue of March 8th, 1884.

(89) W. W., Columbus, O., writes: Please inform me of the best method for determining the size of pulleys on the line shafts and engine shafts to run at a desired speed. *A.*—Your question is very indefinite; probably the answer to Question 22, in our issue of January 14, current volume, will give you the desired information.

(90) Reader, Lacoma, N. H., writes: Being one of the stragglers in the army of mechanics who have foolishly neglected to improve their opportunities to study, I am now endeavoring to catch up. Some time ago, I undertook to study machine design, but was immediately tripped by the cos, sec. and log. So when I attempt to do any designing I blindly lay out something, with the nearest thing as a starter, but which is never very near, when I am crazy enough to try a little inventing. Now will you kindly mention some publications which I can study to become a designer and fit myself to start up and take charge of a shop for the manufacture of highly accurate work of an interchangeable character; in short, to become a first class machinist? For one thing, I realize the value of the AMERICAN MACHINIST to an ambitious mechanic. *A.*—See article treating on What to Study and How to Study, in our issue of Feb-February 19, 1891.

(91) Euclid, Mechanics Falls, Me., writes: I would like to know what I could do to improve the vacuum in our engine. It is a fore-and-aft compound engine in a yacht; high-pressure cylinder, 4½ inches diameter; low pressure cylinder, 8 inches diameter; stroke, 6 inches; cutting off at ⅝ stroke; piston valves in both cylinders; number of revolutions, 250. Boiler pressure, 175 pounds. The keel condenser is made of brass pipes. Air pump, 3¾ inches diameter, 6 inches stroke, and is connected to the engine. The temperature of the water in the river during July is from 50 to 60 degrees; temperature of the discharge water is 85 degrees. When cutting off at ⅝ stroke, throttle wide open, with a steam pressure of 170 pounds, I get a vacuum of 16 inches, and when the engine is slowed down to half speed the vacuum rises to 26 inches for about two minutes and then falls to 18 inches. The air-pump has rubber disk valves in the piston head, but it has no foot valve. *A.*—The low vacuum may be due to a badly constructed air-pump, but in all probability it is due to the omission of the foot valve. We believe that with a foot valve the vacuum will be much improved.

(92) A. McC., Peterborough, Can., writes: Kindly answer the following question in your columns. We made several tests upon a turbine water wheel, and our difficulty is in figuring up the power of the wheel. We measured the water leaving the wheel by means of a weir, and also applied a friction dynamometer to the wheel shaft. The power as figured from the brake is almost 100 per cent. better than that by the weight of water. Why should this be so? We think that the brake should show less power than the power given from actual weight of water over weir. For instance, the wheel when running empty under a 12-foot 10 inches head makes 310 revolutions; we then reduced the speed by means of the brake to 210 revolutions; the head was drawn down 2 inches, making the head 12 feet 8 inches; at this speed the water over our weir (which is 165 inches wide) was 4¾ inches deep. The power required to compress the spring at the end of the lever, which is 6 feet 2 inches from center of wheel shaft to where the center line of spring meets the lever, was 133 pounds; we used a spiral spring. Considering 6 feet 2 inches as the radius of a pulley 12 feet 4 inches diameter, the circumference of which is 38 75 feet, and multiplying this by the number of revolutions, and also by the weight required to compress the spring and divide by 33,000, we have the horse-power; thus:

$$\frac{38.75 \times 210 \times 133}{33{,}000} = 32.7 \text{ horse-power.}$$

Then again by the water we get another answer; we figure it out thus: Number of cubic feet of water discharged, 714; weight of water, 62½ pounds per cubic foot; then we have

$$\frac{714 \times 62\frac{1}{2} \times 12.66}{33{,}000} = 17 \text{ horse-power nearly.}$$

The power to compress spring, head of water, and water over weir, we know to be correct. Where does the discrepancy come in? *A.*—The power computed from the energy of the water as you have done, should certainly be greater than that computed from the brake. You have evidently made a mistake in some of your measurements; and from the data you have given us we cannot say where the mistake has been made, but we are inclined to believe that the quantity of water (714 cubic feet *per minute*) is not correct.

(93) F. P. W., Albany, N. Y., writes: Please inform me how I will have to alter an engine in order to increase its speed. The boiler pressure is 85 pounds; diameter of cylinder, 15 inches; stroke, 36 inches. What I want to do is to increase the speed from 45 to 60 revolutions per minute. She is a slide valve engine, cuts off at ¾ stroke. The governor pulley on the crank shaft is 14¾ inches, the one on the governor is 8¾ inches. Do you think that changing of the speed of the governor will help me any? Or would it help me any to run the engine with a higher boiler pressure, or is the present pressure sufficient? *A.*—To increase the speed of the engine the speed of the governor should not be changed; therefore the diameter of its pulley will have to be increased. To compute this, multiply the diameter of the present pulley on the governor by the increased speed of the engine, and then divide the product by the present speed of engine, thus:

$$\frac{8.75 \times 60}{45} = 11.666 \text{ inches for diameter}$$

of the pulley on the governor. This can be computed in another way. The increase of speed is just ⅓ of the present speed; therefore the diameter of the governor pulley should be increased by ⅓ of its present diameter; hence we have $\frac{8.75}{3} = 2.916$, and $8.75 + 2.916 = 11.666$ as before. Should it be desirable to change the governor pulley on the shaft, then multiply its present diameter by the present speed and divide by the increased speed, thus: $\frac{14.75 \times 45}{60} = 11.06$ inches for the new pulley on the shaft. Of course with this decreased diameter of the shaft pulley, that on the governor will remain 8¾ inches in diameter. Now in order to keep the speed of the line shaft as before, the engine driving pulley will have to be decreased, or the pulley on line shaft increased. To find the diameter of the engine driving pulley, multiply its diameter by the present speed and divide by the increased speed, thus: If this pulley is at present 50 inches diameter, then it will have to be decreased to $\frac{50 \times 45}{60} = 37.5$ inches. If it is desirable to increase the diameter of the pulley on the line shaft, and if its present diameter is, say 50 inches, then it will have to be increased to $\frac{50 \times 60}{45} = 66.6$ inches. If the engine develops sufficient power for the work it has to do, there is no necessity of increasing the pressure unless arrangements are made to cut off earlier in the cylinder, which will produce economy in fuel.

(94) R. B. S., Delaware, Ohio, writes: If we assume a railroad train weighing 500 tons of 2,240 pounds, to be moving at 15 miles per hour, or 22 feet per second, we conclude that the weight of the train (1,120,000 pounds) would have to fall 7.5 feet to attain that velocity, and therefore there are 8,400,000 foot-pounds of work in the train. We conclude that if we divide this by 33,000 we will have the horse power required for one minute to put the train to that speed. As 15 miles per hour is 1,320 feet per minute, it would appear that if we divide the 8,400,000 foot-pounds by 1,320 feet, we should obtain the total resistance of the train, or 6,363 pounds, which is $\left(\frac{6.363}{500}\right)$, about 12 pounds per ton of train. But we know from tables of experiments that it does not require 12 pounds per ton of train to keep a train moving at 15 miles per hour. We do not understand why our conclusions are wrong, unless the formula for accelerated motion is not applicable. We understand that if we assume a pull of 10 pounds per ton, or 5,000 pounds for the train, that $\frac{8{,}400{,}000}{5{,}000} = 1{,}680$ feet is the distance through which the 5,000 pounds must be applied to attain a speed of 15 miles per hour. But when we attempt to reverse the process and figure the resistance per ton from the foot pounds in the train, we obtain wrong results when measured by practice. We understand that foot-pounds is the product of weight into space, and means work performed. Therefore, if we desire to ascertain the work performed by a locomotive moving at the rate of 15 miles per hour, or 1,320 feet per minute, and putting a strain on the tender draw-bar of 5,000 pounds, we have $\frac{1.320 \times 5{,}000}{33{,}000} = 200$ horse-power of work. This appears all right, but when we, as explained, first ascertain the total foot-pounds of work in the train, and attempt to obtain the gross resistance of the same by dividing the total foot-pounds by the speed of train in feet per minute, we get apparently wrong results. We do not see why our result is wrong. Will you please enlighten us on the subject? *A.*—The 8,400,000 foot pounds as you have computed it is equal, or nearly so, to the kinetic energy, or the amount of work stored up in the train, and it does not represent the total amount of work done in giving to the train a velocity of 22 feet per second. The kinetic energy is found by the formula, $\frac{1}{2} m v^2$, in which m represents the mass of the train, and v represents the velocity in feet per second. The mass is obtained by dividing the weight of the train by the acceleration due to gravity, which we may take at 32.2 feet per second. The weight of the train is 1,120,000 pounds, hence the mass is $\frac{1{,}120{,}000}{32.2} = 34{,}782$ (in which the fraction is neglected). The square of the velocity per second is $22 \times 22 = 484$; and the kinetic energy will be $\frac{34{,}782 \times 484}{2} = 8{,}417{,}244$ foot pounds; this is the stored up work, and is the work done against resistance due to acceleration, and it does not include work done against the resistance due to friction, etc. To compute the latter, we should know the distance through which the train has moved at the instant it has attained a velocity of 22 feet per second, and we should also know the train resistance per ton; the product of this resistance into the distance will give the work done against the train resistance, and this must be added to the 8,417,244 foot-pounds due to acceleration; the sum will be the total work performed. But the kinetic energy itself represents the energy which a body can exert in doing work, or overcoming resistance, and the train cannot come to a stop before the whole 8,417,244 foot-pounds have been expended. If, now, the train resistance is 8 pounds per ton, then the resistance for the 500 tons will be $500 \times 8 = 4{,}000$ pounds, and the train will move through a distance of $\frac{8{,}417{,}244}{4{,}000} = 2{,}104.3$ feet before it stops. And conversely, if we know the distance through which the train will move before it comes to rest, then we divide the kinetic energy by the distance through which the train moves; the quotient will be the train resistance. These remarks also show that your other calculations are not correct, and indicate the proper way of handling such questions. Indeed, your question affords a good illustration of a very important point connected with the expenditure of work in a machine, as Prof. A. B. W. Kennedy clearly shows in his "Mechanics of Machinery." If the body accelerated—here the train—is to come to rest, it must get rid of all the work stored up in it in virtue of its velocity. It may be expended in doing work on the train in which it is stored up, in which case the train simply continues moving until all the stored up energy is exhausted and then stops. Or some fresh work may be provided for it to do; for instance, the work in overcoming the resistance of the brakes when applied, upon which the energy expends itself until it is exhausted, as before. In this example we have two kinds of work performed, that which is expended in overcoming the train resistance, and that due to acceleration. These two quantities should be computed separately, and should not be confounded with each other.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Note the cat on page 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells. Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N. Y.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

A. D. Pentz, Consulting. Tools, Elizabeth, N. J.

See Gage advertisement below.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Gage Tool Co.'s Self Setting Plane does more and better work in less time. On trial. Vineland, N. J.

Drop Presses, Punches and Shears. Williams White & Co., Moline, Ill., manufacturers.

For Foundrymen's Metallic Pattern Letters and Figures, send to Knight & Son, Seneca Falls, N. Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

S. A. Smith, 23 South Canal Street, Chicago, Ill. agent for Holbrook's Raw Hide Blanks for Gears.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

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For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

Save small iron from foundry refuse. It pays Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.

25", 32", 37", 42" — "Only Drill Press built on 'Ko-rekt' principles, Even if they come from Jersey." Gould & Eberhardt, Newark, N. J.

Complete treatise on Screws and Screw-making, with clear and concise explanation of the methods; 95 illustrations. Price, $1.25 postpaid. E. & F. N. Spon, 12 Cortlandt St., N. Y.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases.
31 Nassau street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Points from Hartford—Hardening by Grinding—Swaging Wire.

BY JARNO.

Since my article of January 21st, a correspondent, whose name is Hotproof, has written expressing his disbelief in the possibility of hardening steel in the process of wet grinding, because he believes that it is impossible to heat steel by the friction of a stone that is running in water. I wrote to Hartford, and received the testimony of one that has ground the steel and of those that have seen it ground. Hotproof avers that this is not enough for him, and that he will not believe until he has himself actually seen the operation. Again from Hartford: "If Hotproof wants to see the operation performed so as to result in hardening, we shall be pleased to show it to him, if he will pay his fare to Hartford, and pay us for spoiled stock and for misspent time. We will charge at only usual rates. I have known misspent time to cost much more, though not in Hartford. If he raises doubts in his own mind as to facts because they are new to him, even though old to others, he should either remove the doubts himself or pay for their removal."

I have lately visited my Hartford acquaintance, and have obtained the following points which I here repeat in his own words, as near as I can remember, before completing the copying of his letter:

"I wish that I could obtain some book that treats upon press work, the making of drop-hammer dies and of drop forgings.

There are many books from which we can learn the average cutting speeds of turning and planing tools. I could, no doubt, without experimenting, determine the speed to start up a new lathe or planer.

"With the speed of a press punching holes, for instance, the case is entirely different, as I do not find anything published on this subject. Taking four representative books, I do not find anything in Appleton's Cyclopedia of Applied Mechanics, in Haswell, in Nystrom, or in Rose's Modern Machine Shop Practice. In punching holes through sheet metal a sixteenth to one-eighth inch thick, the diameter of the holes being at least twice the thickness of the metal, I am told that a press has made about 180 strokes a minute. In another case, in which the diameter of the holes is less than the thickness of the stock, the holes being 1½ inches diameter, and the stock 2½ inches thick, six holes were punched in a minute. I have seen a nut blank having a hole less than a quarter of the thickness of the blank, the hole being seven-sixteenths inch diameter, and said to have been punched. Now I can obtain only vague opinions as to the best speed to punch nuts of this kind. Every one that I have asked is of the opinion that these nuts should be punched very slowly; but I do not know how to start up a machine at this speed. If ten strokes a minute is slow, what number of strokes is very slow? The word *very* has no place in a machine shop where it is liable to run up against both hot and cold iron. Hot and cold, fast and slow, are sufficiently indefinite for a machinist's use without loading them with 'very.' I should expect that a punch, being subjected to friction upon all sides, could not be run so fast as a planer tool; but I should like to know from the experience of others what are practical speeds."

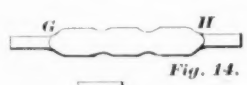


Fig. 14.

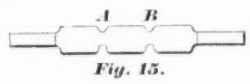


Fig. 15.

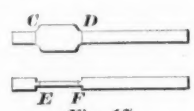


Fig. 17.

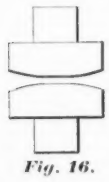


Fig. 16.

Upon my return from Hartford I tried without success to find something published on the speed of punches. I then wrote a letter and received an answer, of which the following is an extract: "The time required to force a punch seven-sixteenths inch diameter, through wrought-iron an inch and five eighths thick, is one and three-quarter minutes; the same time is required to force a half-inch punch through two inch iron. Perhaps either can be done in a trifle less time, but I do not think that this would be practicable; we know that we could not punch one of these holes in one and a quarter minutes, as the punch broke at every trial. In one and three-quarter minutes we had no trouble, and after punching say a hundred holes we could not see that the punch had worn in the least.

"We hardened the punches for this work as we harden those for all cold punching. We harden them all over, and make sure that they are *hard;* then we set the end that is to do the work on hot iron and allow it to be drawn until the color is run below a blue, or, as we call it, a white. The punch is thus drawn lowest on the point, and is left harder and harder toward the shank, as it must be, or it will spring.

"I have no objection to your using my name in the AMERICAN MACHINIST in connection with this subject.

"Trusting that this will be satisfactory, and assuring you that I will cheerfully give any further information to you that I can on this subject, I remain, yours truly,

PAWTUCKET MANUFACTURING CO.,
GEO. H. WEBB, Gen'l Supt."

This letter, in addition to the one from Hartford, was very gratifying to me, as coming from a man that I have met only in business hours, and as being, like the Hartford letter, still another evidence that we mechanics are tending toward the keeping of fewer trade secrets. Waubug Mephit appears to have many of them—in fact, I sometimes think that he has a mysterious way of keeping to himself things that he does not know. When we touch upon one of his trade secrets (?) either he shuts in like a box turtle, or over his face there falls a chilling veil which thickens so that we see him as in the depths of an iceberg. I am in doubt which fellow I should go farthest not to meet, a punning contortionist of conversation, or a trade secret fiend. Mephit likes to talk but not to converse. It is amusingly vexing to watch him lead along until he is asked the question that rings in either his box turtle act or his iceberg act. He makes the very remarks that might lead one to ask how a certain thing is done in order to have an opportunity to refuse to tell. It is always gratifying to read a letter like Mr. Webb's, and after hearing Mephit talk it is refreshing, and so I am carrying the letter around with me for the sake of reading it again and again.

"This lack of printed knowledge pertaining to some mechanical pursuits, noticeably in press work, was called to mind by an experience in swaging wire. We wanted a flat place about six inches long between *G* and *H*, Fig. 14, the ends being left round. For some time we had been doing this, in an old press, with flattening dies without grooves, the edges of the flat part coming out finished without being formed by the dies. This press, together with the dies, was sold. A new press was set up and new dies made. To our surprise the wire was not then flattened evenly. We do not flatten the entire distance between *G* and *H* with one stroke of the press, but with several strokes, the dies being narrower than the distance *G H*, the wire being moved until *G H* is covered. Now with the new dies the flattened part had wide and narrow places, as in Fig. 14, the wide places corresponding to the number of strokes of the dies. Two corners of the dies were rounded upon opposite sides, as in Fig. 16, the other two corners were left sharp.

"After struggling with the difficulty for a time long enough to become well out of patience, in sheer desperation I changed the position of the wire so as to bring the sharp corners of the dies into action, and at once produced a flattened place of the shape in Fig. 15, which was not at all suited to my purpose, but it had the effect of suggesting a way out of the difficulty. As will be noticed, the wire in Fig. 15 has well defined depressions *A B* between a series of flat places, and the flat places are nearly of equal width throughout. The reason for this can be readily understood by glancing at Fig. 17, in which one stroke of the dies has flattened a place between *C* and *D*, the wire being struck by the dies across their sharp corners. It is obvious that the sharp corners spread the wire abruptly, leaving well defined shoulders at *C D* or *E F*. Now if we move this wire along and spread another place beyond *D* or *F*, as between *A B*, Fig. 15, it is evident that the new wide place cannot be joined to the old one, because the wire stretches endways as well as spreads sideways, and in stretching it is impossible for the two wide places to be joined just at the shoulders. I soon concluded that the dies had been rounded to a curve of too short a radius. If sharp corners leave depressions *A B*, Fig. 15, then dies having corners not sharp will leave depressions less pronounced, or with shoulders not so square across. I immediately gave the dies a curve of longer radius, something like Fig. 16. The wire was then flattened all right. Upon looking over old pieces of wire I found that we had never flattened them quite exactly parallel, but that they had been so near that their irregularities were not noticed.

"I have no doubt that this whole matter of swaging wire is entirely familiar to men working with presses, but so far as I have been able to learn, their knowledge has not found its way into publications available to machinists. Press makers might do well to publish something upon the practical workings and the capabilities of their machines."

MANUFACTURES

P. W. McKittrick will start a machine shop at Monroe, La.

Grand Rapids, Mich., will spend $10,000 on a new pumping station.

John Bringhurst is enlarging his rolling-mill at Marshallton, Del.

T. J. Cady and others will erect an iron foundry at Columbus, Miss.

New machinery will be put in the Bonsack Woolen-mills, at Bonsack, Va.

The machine shop of the Jackson Shell Roll Co., Pawtucket, R. I., is to be enlarged.

The Caddo Fertilizer Co., Shreveport, La., will replace its factory recently burned.

The Molders' Facing and Mineral Paint Company will establish a plant at Dundas, Ont.

The Virginia Manufacturing Co., at Suffolk, Va., is reported as erecting machine shops.

Attempts are being made for the erection of another cotton-mill at Rockingham, N. C.

New machinery will be placed in the Mulberry Farms roller-mills at Philadelphia, Tenn.

The Titusville (Fla.) Electric Light Co. has enlarged its building and will put in new machinery.

The Wisconsin Central Railroad Company will enlarge its car shops at Stevens Point, Wis., this year.

It is reported that the Ford Boiler Cleaner Co., of Norristown, Pa., will establish a plant at that point.

The Hepburn Elevator Company, of Hepburn, O., has been chartered, with a capital stock of $5,000.

At Franklin, N. H., the Burley Automatic Gates Co. has been organized, with a capital stock of $50,000.

The recently burned American Foundry and Machine Works at Bowling Green, Ohio, are being rebuilt.

Report says that J. W. Pike will erect a factory at Amsterdam, N. Y., to manufacture knitting machinery.

J. H. Cole & Co., of Parkersburg, W. Va., will establish a foundry and machine shop at Bridgeport, Ala.

Fay & Scott, of Dexter, Me., founders and machinists, will extend their plant by an addition, 50x90 feet.

The Dalton (Ga.) Ice and Cold Storage Company will increase the capacity of its plant and add new machinery.

J. P. Little, Sumner, Fla., will put new machinery in his saw mill, for the manufacture of barrels and hoops

The Hartman Manufacturing Co., of Pittsburgh, Pa., will establish a branch of their works at Hamilton, Ont.

J. M Brosius will, it is stated, erect a factory in Atlanta, Ga., for the manufacture of the Brosius cotton-gin.

Howard Bros., of Worcester, Mass., card manufacturers, propose to increase their business by erecting a mill.

The Kidder Machine Company, at Franklin, N. H., has voted to double its capital stock and add more machinery.

It is stated that the Allegheny Railroad Company will enlarge one of its machine shops at Verona, Pa., this summer.

Plans for the new mill of the Kerr Thread Co., Fall River, Mass., are being made. The dimensions will be 140x130 feet.

The citizens of Grand Junction, Col., have pledged $100,000, for the purpose of establishing a smelter at that point.

The Wentworth Spring and Axle Company, of Gardiner, Me., are seeking a location in some Massachusetts town.

Parties have purchased and will put in operation the Murray & Stevenson foundry and machine shop at Anniston, Ala.

The New England Cotton Manufacturing Company, of Woonsocket, R. I., is to erect an 80,000 spindle mill in the spring.

The Schenectady Locomotive Works, of Schenectady, N. Y., will soon commence the erection of a new foundry 100x380 feet.

The Ettrick Manufacturing Company, Petersburg, Va., is putting new twisting and winding machinery in its cotton-mill.

Work will soon be commenced on the erection of a new foundry, 100x380 ft., for the Schenectady Locomotive Works, of Schenectady, N. Y.

Brown & Rettig are reported as to erect a new factory at Chattanooga, Tenn., for the manufacture of ice; capacity to be 50 tons per day.

A bill incorporating the Tabb & Jenkins Hardware Company, of Baltimore, Md., has been introduced in the legislature at Annapolis.

The Thistle Wire Co. at Lee, Mass., will increase its manufacturing facilities, and is negotiating for the purchase of property for a new plant.

The Excelsior Machine and Cleveland Punch and Shear Works Company, of Cleveland, has been chartered, with a capital stock of $125,000.

The New Orleans (La.) Water-works Co. will issue $250,000 of bonds to enlarge and repair its machinery for the furnishing of filtered water.

Repairs on the Worcester Steel Works, at Worcester, Mass., are being made preparatory to starting up the plant under the new management.

The foundry and machine shop of G. R. Sisson, at New Bedford, Mass., has been bought by H. L. Gleason. A yarn-mill may be built on the property.

Work on remodeling the old Flood Foundry at Decatur, Ill., for the new corrugating company has commenced, and will be rapidly pushed to completion.

Subscriptions to the amount of $80,000 have been made for the purpose of securing the erection of the Delano Iron and Steel Works, at Tacoma, Wash.

A company, of which J. G. Ulsey, of Boston, Mass., is president, has been incorporated, at Portland, Me., to manufacture machines for toilet paper.

The Mammoth Manufacturing Co., of Birmingham, Ala., capital $1,750,000, has been incorporated for the manufacture of agricultural implements.

The Central Electric Light Co., Lexington, Ky., contemplates adding to its boiler capacity and putting in automatic stoker, and the most approved furnace.

The new blooming-mill addition to the Midland Steel Company's plant at Muncie, Ind., will be 64x144 feet, and will give employment to an additional 150 men.

The United States Iron Company has been incorporated at Newark, N. J., with a capital of $10,000, for manufacturing and milling wrought and cast-iron and steel.

The Canadian Steel Barge Co. has been incorporated at Port Arthur, Ont., with a capital stock of $128,000, to build steel vessels for freight and passenger service.

The Crawford Manufacturing Co., Hagerstown, Md., is erecting an addition 30x30 feet to its bicycle factory. The new building will be used as a polishing room.

The Gould Coupler Co. is building machine shops at its Black Rock works near Buffalo N. Y., at a cost of about $15,000, for the manufacture of the Cowell platform.

There is talk of the establishment of a plant at Kingston, Mass., for the manufacture of the Holmes Graphite Fiber, a patent compound for machinery bearings.

The Todd Cotton Harvester Manufacturing Company, Chicago, Ill., has been organized, with a capital stock of $5,000,000, to manufacture cotton-picking machines.

It is considered probable that the shops of the Queen & Crescent at Meridian, Miss., recently destroyed by fire, are soon to be rebuilt upon a larger scale than formerly.

The Bain Manufacturing Co. is a new organization at Bridgeport, Ala., which is considering the establishment of a plant for the manufacture of wrought-iron fencing.

The Seneca Construction Company, of Jersey City, N. J., has been organized, with $300,000 capital stock, for the construction of bridges and other public improvements

Mr. W. S. Rogers has sold out his interest in the Ideal Drawing Stand to M. C. Hamett, Troy, N. Y., who is also to manufacture an improved car ventilator of Mr. Rogers' invention.

The Greenfield, Ind., city council has passed a water-works ordinance, and on April 6 will receive proposals for the construction of a plant at the estimated cost of $25,000.

The Hopper Aluminum Co., capitalized at $1,000,000, and the Pacific Coast Aluminum Co., also capitalized at $1,000,000, have filed articles of incorporation at San Francisco, Cal.

The Beaumont (Texas) Car Works has issued bonds to Boston, Mass., parties, and it is said that the buildings will be completed and equipped with machinery in the near future.

The Corning Steel Company have signed contracts to establish their plant at Hammond, Ill. The company are capitalized at $1,000,000, and will erect works costing $300,000.

J. D. Laughlin, Vicksburg, Miss., will receive sealed proposals until March 7 for the construction of an iron bridge over Big Black River, at Baldwin's Ferry, in Warren County.

T. H. Butler, J. W. Faggerty and W. T. Chapin have incorporated the Oak Terrace Cold Storage Co., at South Jacksonville, Fla., to manufacture ice, etc. The capital stock is $25,000.

It is said that the Ducktown (Tenn.) Sulphur, Copper & Iron Co. will build a copper-plating mill and a plant for making copper wire.

The Denver Steel Rolling-mill Company have been incorporated at Denver, Col., for the manufacture of barbed wire, nails, wire rods, cotton ties, etc. The capital stock is $250,000.

The New England Screw Co. has been organized at Saco, Me., for to manufacture metal screws, rivets and electrical supplies. The president is Charles H. Morse, of Brockton, Mass.

The Northey Manufacturing Co., at Toronto, Can., builders of steam engines and boilers, and of all kinds of iron machinery, have received their letters of incorporation; capital stock, $100,000.

The capacity of the Baker Chain and Wagon Iron Manufacturing Co., of Allegheny City, Pa., will soon be doubled, when the improvements, in the shape of machinery, tools, etc., are completed.

The Mobile (Ala.) Dry Dock Company has been reorganized, with O. F. Cawthon, president, and Henry Hanaw, secretary and treasurer, for the early construction of a dry dock or marine railway.

Atlanta, Ga., parties have, it is reported, purchased 640 acres of phosphate land at Arcadia, Fla., from Mr. Widden for $8,000, and will organize the Atlanta & Florida Phosphate Company, to develop same.

The Marine Iron Co. has been incorporated at Bay City, Mich., by Wm. Burnett, John H. Davis and others, with a capital of $32,000. The purpose of the company is the manufacture and sale of machinery, boilers, etc.

On account of increasing business S. & W. C. Co, ran, of Utica, N. Y., have bought property just west of their machine shop, and will erect a four-story brick building, 40x46 feet, for manufacturing and machinery purposes.

It is stated that a $250,000 stock company will be organized at Augusta, Ga., to manufacture the patent wood-working machine of the National Lathe and Tool Co., of Philadelphia, Pa. James U. Jackson can give information.

M. L. Marble, J. E. Burch and H. N. Michael have purchased the engine and machine works of Gomber & Burch, at Frederick, Md., and will operate same under the name of the Frederick City Engine and Machine Works.

J. H. Wilson, J. H. Rogan and others, will build, at Mobile, Ala., an incandescent electric light plant of 5,000 lights, and a power plant to operate electric railway. They will use three Corliss engines of 250 horse-power each.

Vernor Voldo, of Nevada, proposes to organize in Dallas, Tex., the Columbian Light, Heat and Power Co., to furnish light, heat and power under franchises obtained from the Columbian Light, Heat and Power Co., of Chicago, Ill.

The Lisk Anti-Rust Tin Company, of Canandaigua, N. Y., have purchased property, and will erect a plant at Clinton Springs, N. Y., to accommodate their manufacturing upon their removal to that place in the near future.

The Wendt Car Coupler Company, of Marshfield, Wisconsin, has been formed, with capital stock of $200,000 for the manufacture of the Wendt patent coupler. E. Wendt, A. C. Wendt and W. H. Wendt are the promoters of the enterprise.

The property of the Brosius Motor Sewing Machine Co., Atlanta, Ga., has been purchased by a new company, known as the Southern Manufacturing Co., which will continue the manufacture of the Brosius motor sewing machine.

James M. Barco, P. M. Colson and W. J. Epperson, have incorporated the Bronson Pebble Phosphate Mining and Land Company, at Bronson, Fla., to develop phosphate mines, manufacture fertilizers, etc. The capital stock is $150,000.

The Lackawanna Iron and Steel Company, of Scranton, Pa., has announced that hereafter, until further orders, their lower steel-rail mills will run full time, and the upper mills double time. Fully 300 men will be furnished work by this order.

At Goshen, Ind., the Goshen Machine and Foundry Co. has been organized with a capital of $12,500 to carry on the business of manufacturing machinery and iron founders; incorporators, Arthur E Brownell, James M. Wisler, Wilber Stonex.

The Queen City Iron Company, of Queen City, Texas, have filed a charter. The capital stock is $400,000, and the object of the corporation is to manufacture pig-iron, fire brick and tiling. It is said that the company will erect a blast furnace.

S. C. Corbin is endeavoring to organize a stock company at Aurora, Ill., with a capital of $100,000, for the purpose of manufacturing a smoke consumer invented by him. The device is now being manufactured on a small scale at Omaha, Neb.

The Murray & Stevenson Foundry and Machine Works, at Anniston, Ala., were sold recently at administrator's sale to Dixon Noble. These shops were run successfully up to two years ago, when they were shut down. Mr. Noble will start them up again.

There is water-works agitation in Nicholson, Pa.; Frankfort, N. Y.; Lacon, Ill.; Lynchburgh, Va.; Provincetown, Mass.; New Haven, Conn.; Holyoke, Mass.; Chicopee, Mass.; Barre, Mass.; Lake Charles, La.; Cambridge, Ohio; Wapakoneta, Ohio; Jacksonville, Ill.; El Reno, Oklahoma.

The machinery for the Frankfort, Ind., shops of the Toledo, St. Louis & Kansas City road is being placed in position, and the shops will be in running order in a few weeks. The new shops will be used as the general repair and car building shops of the company, employing 250 to 300 men.

The Eagle Machine Works has been incorporated at Chicago with a capital of $6,000, to manufacture and sell machinery and tools, and do a general jobbing and repair business on all kinds of machinery and tools. E. E. Barrett, V. Dessallioud, and Herman A. Knoke are the incorporators.

A new erecting shop has just been completed by the Pullman Palace Car Co. for passenger cars, at Pullman, Ill. It is built in a line with the other erecting shops, with which it is connected by means of a transfer table. The dimensions are 200x400 ft. The erecting shops now have a capacity of 200 stalls.

The Philadelphia & Reading has decided to build an extension of 500 feet to its repair shops at Reading, Pa., giving them a total length of 1,250 feet, and employing 800 to 1,000 men, instead of 400 as now. A paint shop, 190x560 feet in size, in which passenger coaches will be repainted, has also been located.

The W. E. Caldwell Co. has been incorporated at Louisville, Ky., with W. E. Caldwell, president, and H. B. W. Wintersmith, vice president and secretary, to manufacture machinery, tanks, mills, factories, etc.; also is privileged to construct waterworks, water towers. The authorized capital stock is $200,000.

At Guildford, Me., a new machine shop is to be started some time this month, the stock having been subscribed in equal parts by Fay & Scott, the Dexter machinists, and the Piscataquis Woolen Co. Suitable quarters for the establishment have been secured, and the arrangements nearly made for business to commence.

Repairs on the old Worcester Steel Works, at Worcester, Mass., are going on at a rapid rate preparatory to the starting up of the plant under the new management. It is expected that the works will be ready to begin operations in about five weeks, when steps will be taken toward forming a stock company to carry on the business.

We have received from H. N. Bates & Co., of Boston, their elegant new catalogue of "Machinery for the Transmission of Power." The catalogue is devoted almost exclusively to transmission devices, shafting, hangers, pulleys, couplings, friction clutches and pulleys, etc. There are also rules and tables for ascertaining the capacity of shafting, pulleys and belts.

Mr. C. E Barnes, superintendent of the Plymouth & Kingston Street R. R. at Plymouth, Mass., reports that he tried gun metal and rawhide pinions on a car of the company, by putting the gun metal pinions upon one end of a car and the rawhide pinion on the other end, so as to be sure that they did the same work. Two sets of the gun metal pinions were worn out, while the rawhide pinions were still in use. The period of trial was seven months, upon a road having heavy grades and sharp curves. The rawhide pinions were made by the New Process Rawhide Company, of Syracuse, N. Y.

The Penberthy Injector Co., Detroit, Mich., who for the past three years have had their factory headquarters or depot with Donegan & Swift, 11 Murray St., New York, have recently made a very large sale of their injectors to the Walworth M'f'g Co., of Boston, Mass., appointing them also as eastern depot for the distribution to jobbers and dealers of the "Penberthy" Injector, and also of their new "Chief" Automatic Injector. This will be appreciated by a large number of buyers in Maine, New Hampshire, eastern Massachusetts and Rhode Island, who in many cases prefer purchasing direct from Boston, and as the articles of their manufacture can be purchased at either of the above depots, at factory prices, it will save the unnecessary delay and expense in sending to the factory for goods.

The Berlin Iron Bridge Co., of East Berlin, Conn., are running their works full time, and are very much crowded with orders. Among other contracts which they have on hand, is an iron building 80 ft.x254 ft., for The True Blue Marble Co., at West Rutland, Vt.; an iron building 52 ft.x170 ft., for The Chester Pipe & Tube Co., at South Chester, Penn.; a boiler shop 68 ft.x201 ft. and a machine shop 72 ft.x184 ft., for The Dry Dock Engine Co., at Detroit, Mich.; a boiler shop 115 ft.x370 ft., for The Wm. Cramp & Sons Ship & Engine Building Co., at Philadelphia, Penn.; all the iron work including the beams, girders, roof, etc., for a new building which The National Fire Ins. Co. are building at Hartford, Conn.; an iron boiler house for The Montgomery Furnace, at Pt. Kennedy, Penn.; a new casting shop 69 ft.x167 ft., for The American Tube Works, at Somerville, Mass. They have just completed a large iron building for The Delaware Iron Co., at New Castle, Del., and also a large iron building for The Boston & Montana Consolidated Silver & Copper Mining Co., at Great Falls, Montana. While a great many companies are complaining of slack business, yet The Berlin Company seem to have plenty to do, and are employing their full force full time.

Machinists' Supplies and Iron.

NEW YORK, March 5, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $16.50 to $17.50; No. 2, $15.25 to $16.50; Grey Forge, $14 to $14.50. Southern brands of good quality are obtainable at $15.75 to $17 for No. 1 Foundry; $15 to $16 for No. 2; and $13.50 to $14 for Grey Forge.

Scotch Pig—Coltness is quoted at $21.50; and $20.25 for Eglington.

Antimony—Prices are steady, with good demand for prompt delivery.

We quote Hallett's, 10¾c; Cookson's, 14½c. to 15c.; and L. X., 12c. to 12½c.

Copper—The market is firmer. Lake copper is obtainable at 10.60c. for spot delivery, with 10.50c. bid, and 10¾c. to 10.80c asked. Casting copper is irregular at 10½c. to 10¼c.

Lead—The market is slightly weaker. There are buyers at 4.15c., according to quantity, but supplies are held at 4.20c. It is said that considerable business was done last week at 4.20c. to 4.25c.

Lard Oil—The market is firm at 56c. to 57c. for Prime City. Western on spot is quoted at 55c.

Spelter—The market continues unsatisfactory and nominal at 4.50c. to 4.60c.

Tin—The market is in sympathy with foreign advices. Small sales are reported at 19.60c. The tendency is towards 19.70c. Speculative interest is stagnant.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

An ordinary boss machinist without any fringes wants a job. Address Box 62, AM. MACHINIST.

Agents in every shop to sell the best surface gauges, etc., for part adv. E G. Smith, Columbia, Pa.

Experienced mechanical draftsman desires situation. Box 65, AMERICAN MACHINIST.

Mech'l eng'r desires position as foreman or draftsman with some m'f'g concern. N. S. H., care A. M.

Mechanical draftsman desires position. Address Box 72, AMERICAN MACHINIST.

Wanted—First-class foundry foreman, must be used to heavy engine castings. Address Box 68, care AMERICAN MACHINIST.

Wanted—Two good molders for steam and hot water heater work; none but steady men need apply. Address XX, care AMERICAN MACHINIST.

An A1 machinist wants a position; used to close, accurate work, and an experienced tool maker, intelligent, steady and reliable. F. W., AM. MACH.

Wanted—Mechanical draftsman for detail work chance for advancement if competent. Address Box 58, AMERICAN MACHINIST.

A1 patternmaker; age 45; 15 years' experience; wishes to change. If you want a "pusher," please address K, care AMERICAN MACHINIST.

Wanted—Immediately, general foreman for machine shop; eighty men; medium and heavy work; must be a hustler. Address with references and full particulars. Hustle, care AM. MACHINIST.

Wanted—Opening by young man (26), college graduate, junior member A. S. M. E.; one year machine shop, two years draftsman; east or west. C. S. P., AMERICAN MACHINIST.

Practical boilermaker, age 38, desires situation; ten years' experience as foreman; handled from 50 to 75 men; A1 reference. Address Isaac Fowler, 940 Argyle Ave., Baltimore, Md.

Wanted—An A1 experienced energetic foreman, to take charge of building Corliss engines and heavy transmission machinery; give experience and full refs., and address Box 67, care AMER. MACHINIST.

Wanted—First-class foreman, competent to fill position of assistant superintendent, must understand manufacture of Corliss and high speed engines. Address Engine, care AM. MACHINIST.

Wanted—25 first-class machinists accustomed to Corliss and automatic engine work; steady work and good wages to the right men. Apply to Sioux City Engine Works, Sioux City, Iowa.

Young man desires position, having had charge in a well-known concern—machinery, tools, etc.; able to get out first-class work, and handle men to advantage; first-class ref. F. J., AM. MACHINIST.

A first-class man, having ten years' experience in the manufacture of steam engines on a large scale, on the interchangeable plan and jig system, desires a position as superintendent. Address A. B., care AMERICAN MACHINIST.

Position as draftsman in Mass. or R. I., eight years draftsman on general mill work, interchangeable work, special tools and jigs; also five years machinist; can take charge of men; technical graduate. "System," AM. MACHINIST.

Wanted—By an experienced mechanic, 38 years of age, a position as superintendent with some energetic concern in the manufacture of machinery, etc.; particulars given on application. Box 66, AMERICAN MACHINIST.

Wanted—First-class machinery salesman for Chicago and vicinity; must be well up in machine tools; a good place for the right party with one of the largest manufacturers in the U. S. Address "Masheen," care AMERICAN MACHINIST.

Wanted—Three or four boys to learn the machinist's trade, not less than 17 years of age, and to have a fair common school education. Application must be made in own hand-writing The Hendey Machine Company, Torrington, Conn.

Wanted—A foreman molder, for a growing shop out of town, now employing about six molders. Must be capable of turning out good, smooth castings, and have men do a fair day's work. No unions or walking delegates to bother. A good position to the right man. Address, stating wages wanted (to start with), Box 63, AMERICAN MACHINIST.

Situation wanted on April 1st, by competent mechanic, who has held position as machine shop foreman during 8 years, and as superintendent 2 years, with a firm engaged in the manufacture of engines, boilers, cotton gins, and hydraulic cotton presses; satisfactory reason furnished for wanting to make a change; references furnished. Address Box 70, AMERICAN MACHINIST.

PURE FEED-WATER For Steam Boilers.

THE BUNNELL FILLER AND PROCESS Furnishes Steam Boilers with water that is absolutely freed from all scale producing substances. Guaranteed or no sale.

BRADLEY & COMPANY, SYRACUSE, N. Y.

ELEMENTARY MECHANICS By PHILIP MAGNUS, 14th edition, 12mo, cloth, $1.25. JOHN WILEY & SONS, NEW YORK.

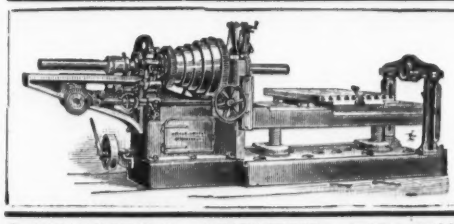
STEEL TUBES WELDLESS SMOOTH · COLD DRAWN John S. Leng's Son & Co. New York.

BRASS AND BRONZE CASTINGS A SPECIALTY. By a molder of 50 years experience. Castings guaranteed true to pattern. Get my prices. GEORGE HIBSCH, 4 1-2 Plain St., Albany, N. Y

CATALOGUE of BOOKS ON STEAM, STEAM ENGINES, MACHINERY, MECHANICS AND MECHANICAL ENGINEERING. 48 Pages, sent Gratis on application to D. VAN NOSTRAND CO., Publishers, 23 Murray & 27 Warren Sts., New York.

FOR SALE. One No. 2 SIMPSON PATENT GEAR MOULDING MACHINE. Will make gears of all kinds, Spur, Bevel, Mortise, Miter, or Worm Gears, from 20 inches to 15 feet diameter. Machine is practically new, and will be sold cheap. STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

POPULAR AND INSTRUCTIVE BOOKS FOR ENGINEERS AND FIREMEN, By STEPHEN ROPER, Engineer. Embracing all branches of Steam Engineering. They are the only books of the kind ever published in this country, and are so plain that any engineer or fireman can easily understand them. *Descriptive Catalogue Mailed Free.* EDWARD MEEKS, Publisher, No. 1012 Walnut St., PHILADELPHIA, PA.

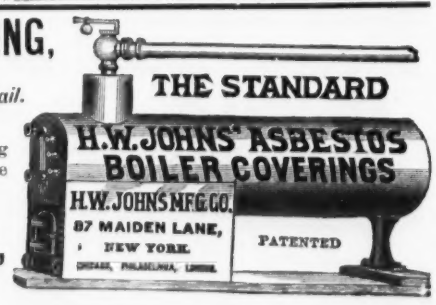


BETTS MACHINE CO., WILMINGTON, DEL. MACHINE TOOL BUILDERS. IMPROVED PATTERNS! LATE DESIGNS!

ASBESTOS CEMENT FELTING, FOR LAGGING LOCOMOTIVE BOILERS. *Samples and Descriptive Price List Free by Mail.*

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO., 87 Maiden Lane, NEW YORK.



Wanted—We desire to arrange with parties—not already engaged in the selling of Tinners' Machines and Tools—to represent us exclusively in the following cities: New York, Philadelphia, Chicago, St. Louis, Kansas City and San Francisco. This is an exceptionally good opportunity for young men thoroughly acquainted with the details of manufacturing tinware by modern machinery to enter into a lucrative business. Exclusive territery and control will be given, and bonds to indemnify us will be required. Address Stark Machine & Tool Co., Buffalo, N. Y.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Best Portable Forge, $12. Am. Tool Wks., Clev., O.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

For Sale—Patent 465,676. High Duty Attachment for Steam Pumps; 100,000,000 Duty. H.D., Am. Mach.

Cheap—Two H. P. Engine Blue Prints complete. Designed to be built on an ordinary lathe. W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

Wanted—A second-hand drop hammer (between 300 and 400 lbs.), Pratt & Whitney preferred. J. B. Armstrong Mfg. Co. (Limited), Flint, Mich.

An engineer (35), good education, business and shop exp, would invest with services in any good man't'g business, New England or N. Y. & vicinity pref'd; give full particulars. Box 69, Am. Machinist.

Wanted—One or two stamping presses for light die work—equal to Bliss No. 19 to No. 21. Address, with description and price, M. & W., care American Machinist.

Bound volumes for 1891. We are now prepared to take orders. Price, $4.00 per volume; express charges payable by purchaser. Address American Machinist, 96 Fulton street, New York.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent, Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Machine Tools in Stock.

ENGINE LATHES.

78	in. swing,	9 ft.	between centers	Sellers
38	do	17 ft.	bed. New	Fifield
30	do	14	do do	do
28	do	12	do do	
27	do	16	do do	
24	do	12	do do	Fifield
24	do	12	do do	Fitchburg
24	do	12	do do	Flather
22	do	10	do New Pattern	Fifield
22	do	12	do do	do
22	do	12	do New	Blaisdell
22	do	8	do do	Flather
22	do	10	do do	do
20	do	8	do do	do
20	do	10	do do	do
18	do	8	do do	do
18	do	10	do do	do
18	do	8	do do	Blaisdell
18	do	15	do do	do
16	do	6	do do	Flather
16	do	6	do do	Blaisdell
15	do	6	do do	Flather
14	do	6	do do	do
14	do	6	do do	Blaisdell
12	do	6	do do	do

PLANERS.

42	in. wide,	42	in. high,	12 ft. long, 2 heads	Gleason
36	do	36	do	8 do	Pease
30	do	30	do	8 do	do
30	do	30	do	8 do	Whitcomb
30	do	30	do	8 do	Flather
26	do	26	do	6 do	do
24	do	24	do	6 do	do
24	do	24	do	6 do	Whitcomb
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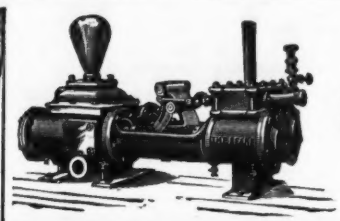

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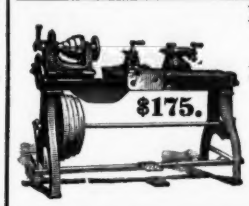

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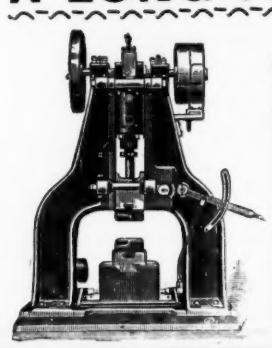

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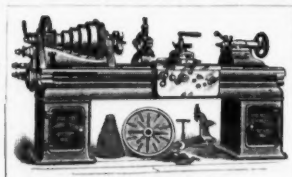

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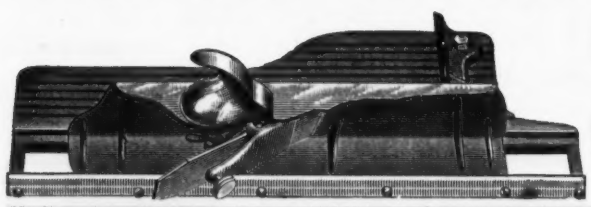

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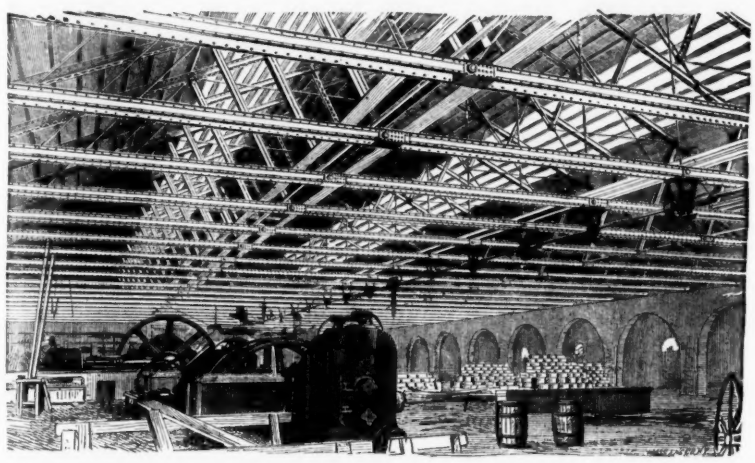

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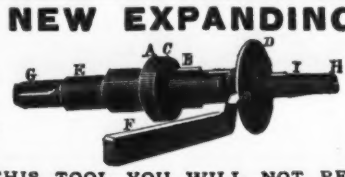

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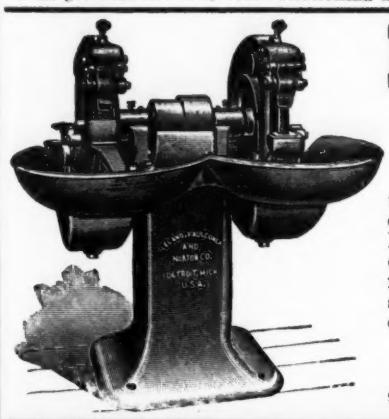

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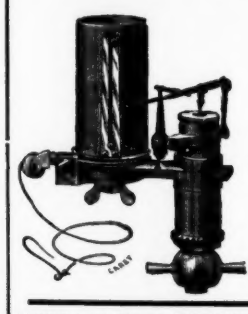

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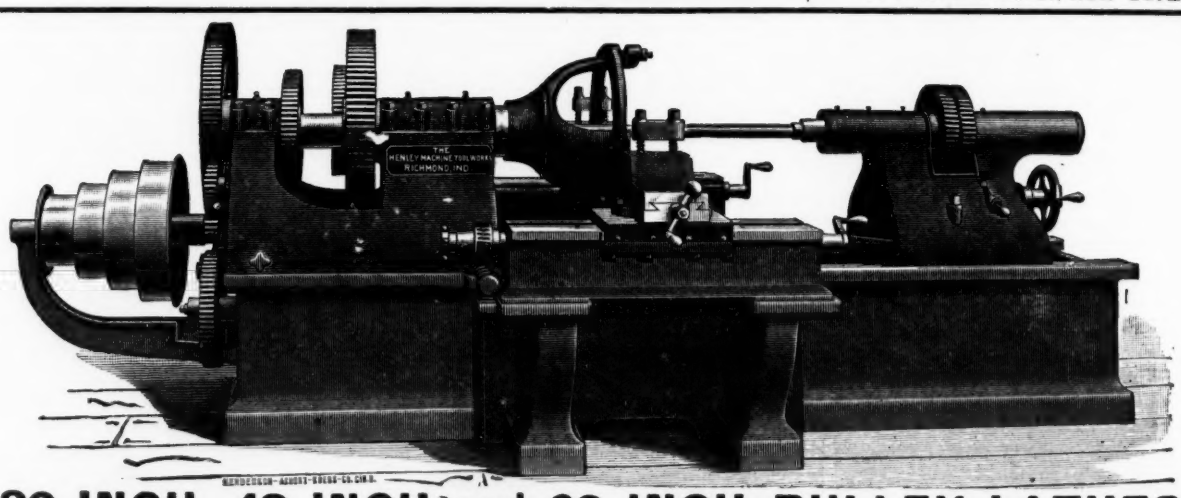

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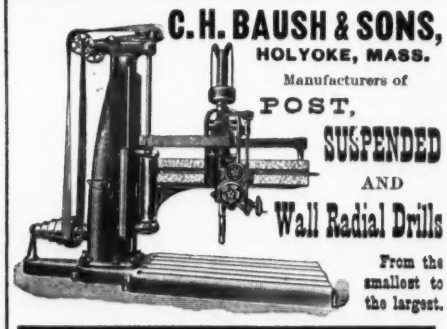

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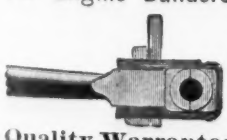

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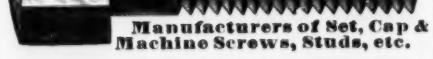

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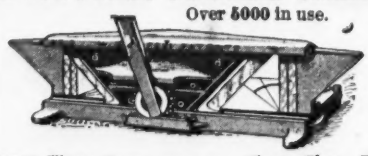

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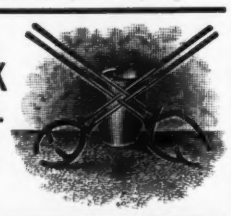

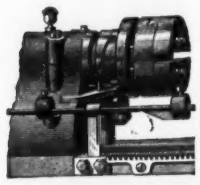

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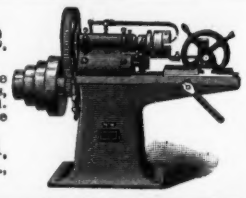

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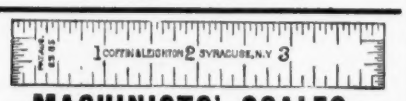

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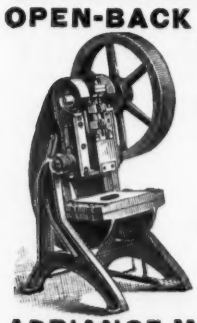

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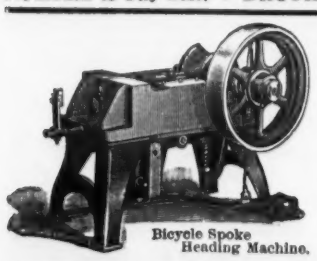

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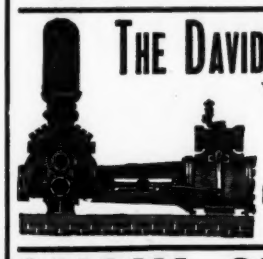

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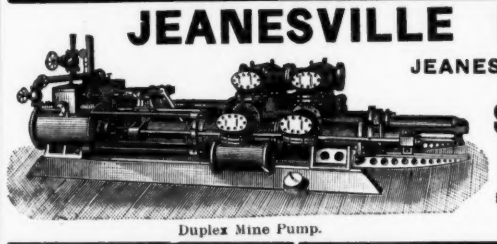
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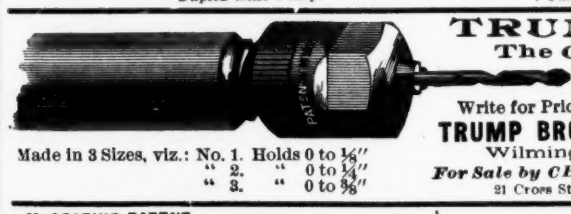

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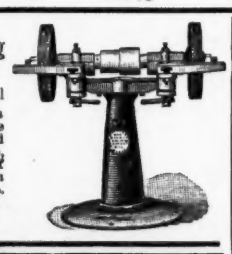

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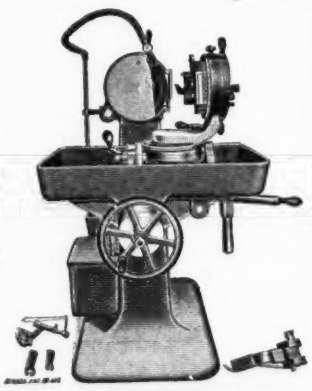

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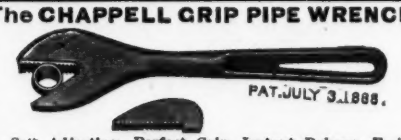

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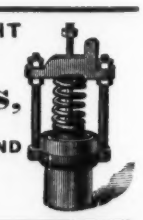

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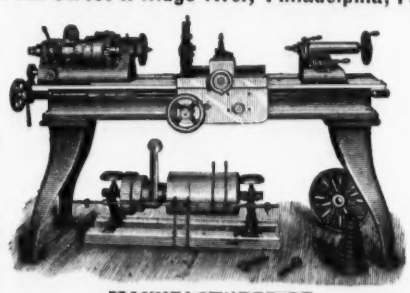

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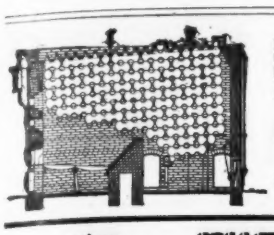

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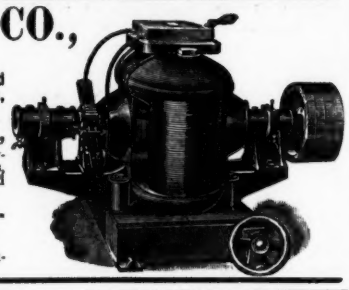

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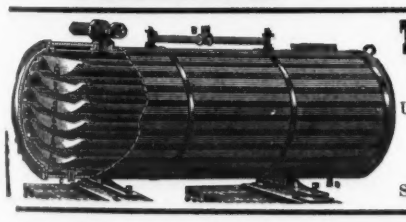

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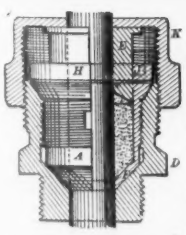

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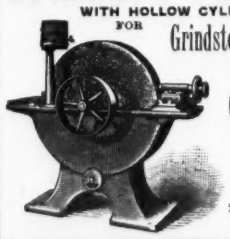

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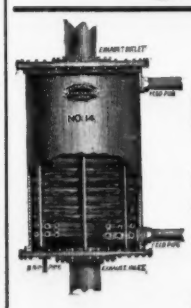

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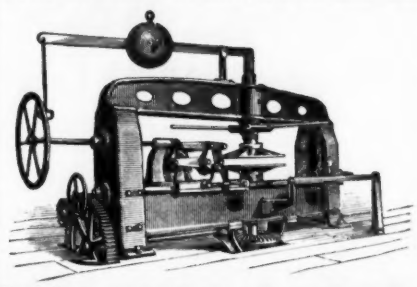

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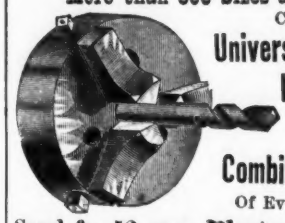

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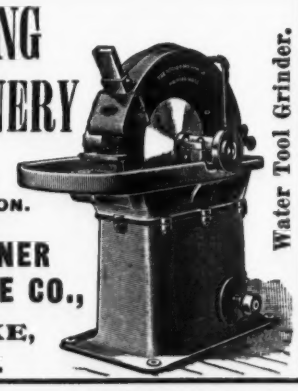

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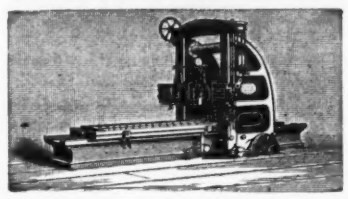

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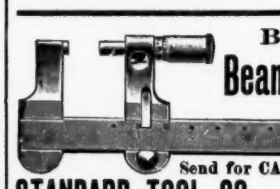

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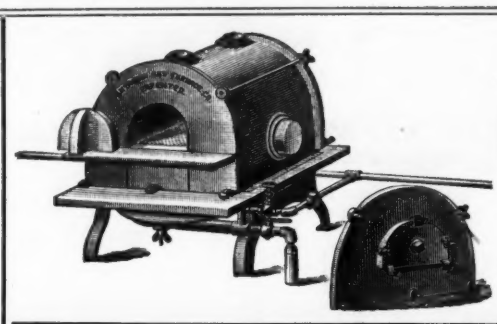

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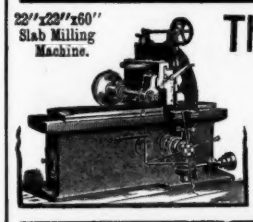

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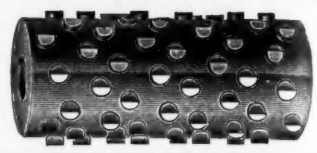

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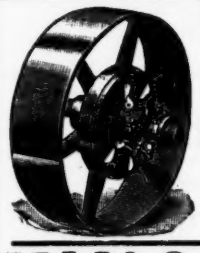

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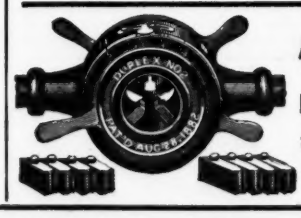

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MACHINERY For Reducing and Pointing Wire.

ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.

For Machines or Information, address the Manufacturer,

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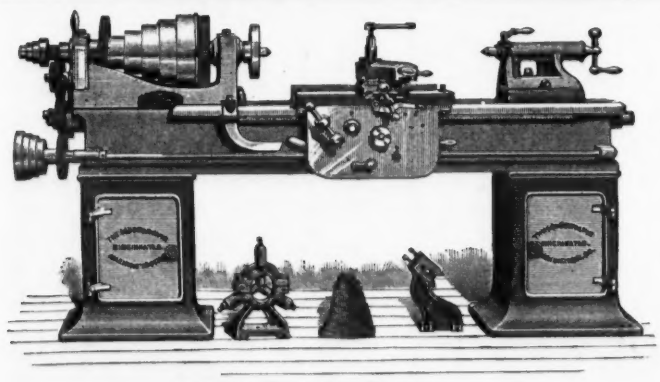

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SPECIAL FEATURES LATHE.

- Graduated Taper Attachment.
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- Graduated Power Cross Feed.
- Reverse in Apron.
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- Automatic Stop.

SPECIAL FEATURES PLANER.

- Extra Deep Beds and Tables.
- Reverse operated from both Sides.
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- Special Oiling Devices.
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- Designed for Extra Heavy Duty.

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WORKS: CINCINNATI, OHIO.

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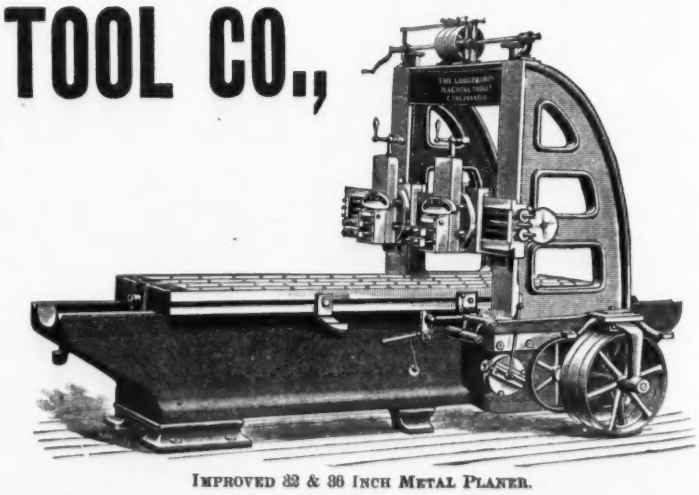

IMPROVED 32 & 36 INCH METAL PLANER.

SEE ADVERTISEMENT ON PAGE 20.

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Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.** New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

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HAND LATHES, FOOT LATHES AND MILLING MACHINES.
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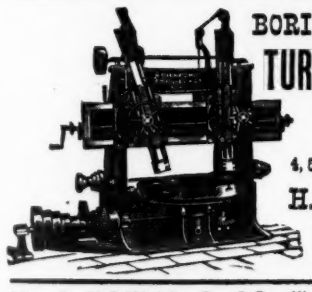

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4, 5 & 6 Ft. Swing.
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W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

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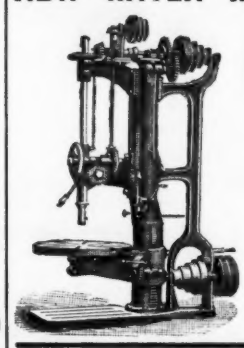

Lathes, Planers, Shapers, Slotters, Etc.

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JONES & LAMSON MACHINE CO.,
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MULLER LATHES

PATENTED.
With New and Valuable Features.
MADE ONLY BY THE
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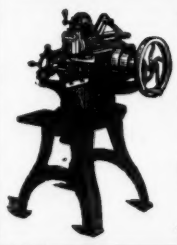
Photographs and Prices on application.



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Manufacturers of
Shaping Machines, Drilling Machines, Bolt Cutting Machines.
CHAS. CHURCHILL & CO., Lt'd, Agents, 21 Cross St., Finsbury, London, England.

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Extra Heavy. Latest Design. All Modern Improvements.

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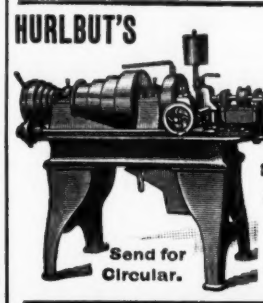

Patent Cutting-off and Centering Machine.
Sizes, 2", 3", 4", 5", 6".
MADE BY
HURLBUT, ROGERS MACHINE CO.
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Send for Circular.

THE BARNES WATER EMERY TOOL GRINDER.

It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.

Sold subject to approval. Send for full description and price

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Address No. 1995 Ruby Street.

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Having just removed to 177, 179, 181 East Pearl Street, this city, where, with more commodious quarters and facilities, we are in still better shape to manufacture our specialty.

CRANK AND GEARED SHAPERS.
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Turret Drill Press.

SIX SPINDLE.

Drills from $\frac{1}{32}$ to $\frac{1}{4}$ hole, speed from 250 to 2000 Rev.

Suitable for a large variety of work and is operated with ease and rapidity.

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Lathes from 10 in. to 20 in. swing. Largest Variety of Drills manufactured in the world
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LAIGHT & CANAL STS., NEW YORK,
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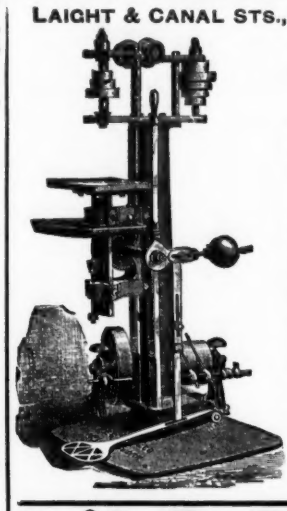
Including Milling Machines, Drill Presses, Hand Lathes, &c.



The machine shown in cut is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

Price $8
NO GAUGES.
NO BELT.
Every Machine Guaranteed.

BARKER'S IMPROVED CENTER GRINDING MACHINE.
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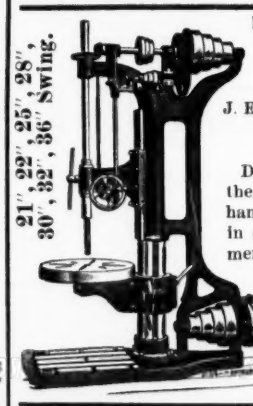


EDISON GENERAL ELECTRIC COMPANY,
SCHENECTADY, N. Y.,
Jan. 12, 1891.

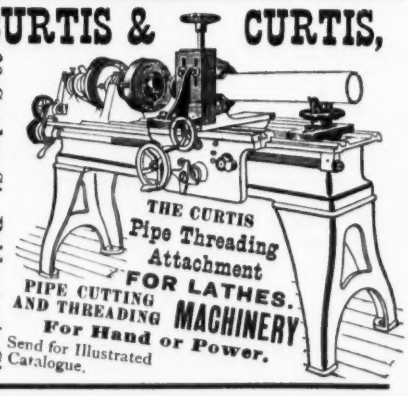
J. E. SNYDER, Esq.,
17 Hermon St.,
Worcester, Mass.

Dear Sir:—Your letter of the 5th inst. came duly to hand. We are now using in our various establishments 60 of your drills, and are very well pleased with them.

Yours very truly,
JOHN KRUESI,
Gen'l Manager.

CURTIS & CURTIS,

66 Garden St., Bridgeport, Ct.



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PIPE CUTTING AND THREADING MACHINERY For Hand or Power.
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The "Simplex" Glass-Tube Cutter.

This simple little instrument will be found quite as effective in its operation as any one of the numerous Glass-Tube Cutters costing five times its price. Its trifling price places it within the reach of every one who has use for such a tool.

PRICE, 25 CENTS EACH.
Or sent by mail to any address upon receipt of a P. O. Money Order for 33 CENTS.
DO NOT SEND US ANY POSTAGE STAMPS.
It Sells at Sight.

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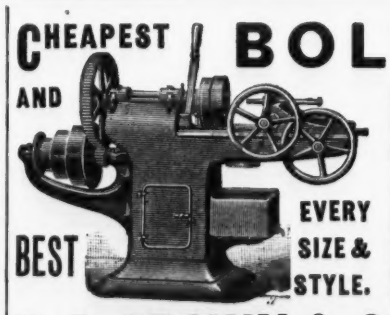
CHEAPEST AND BEST **BOLT CUTTERS.**



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Gentlemen: We are using your DAMPER REGULATOR, and are satisfied that it is paying for itself, in the saving of fuel, since its use we having not had a single blow-off.

Yours respectfully,
CRYSTAL SPRING BREWING CO.,
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PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL.
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE.

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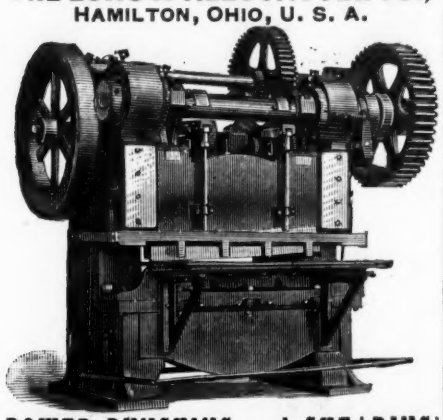
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For Ship Builders, Boiler Makers, Bridge Works, Architectural Iron Works, Carriage and Wagon Makers, Agricultural Implements, etc., etc.
Correspondence stating requirements solicited.

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MACHINE MOULDED GEARING.
ALL KINDS OF TRANSMISSION MACHINERY OF THE HEAVIEST CLASS.
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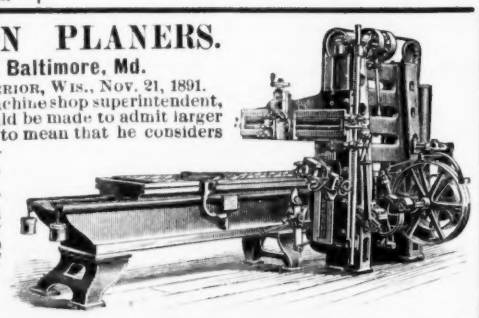
WEST SUPERIOR, WIS., NOV. 21, 1891.
DEAR SIRS: In answer to your inquiry, our machine shop superintendent, Mr. Street, suggests that your tool-posts should be made to admit larger steel, a criticism which might be interpreted to mean that he considers the machine generally to be strong enough to endure heavier work than the tool will now stand.
* * * * * *
We have found it extremely useful and very handy. It has several times helped us out with work which could not have been handled by any other planer at the head of the Lake. We hope to possess ourselves of another one of larger size one of these days.
Very truly yours, W. F. MATTES, G. M.
WEST SUPERIOR IRON & STEEL CO.

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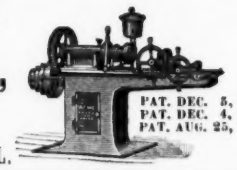
Manufacturers of
ACME BOLT & RIVET HEADERS,
Acme Single & Double Automatic BOLT CUTTERS.
Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
FIRST PREMIUM, CINCINNATI CENTENNIAL.

PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.

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The Champion Forge Co.
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MANUFACTURERS OF
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EXHAUST FANS.
LEVER & CRANK BLOWERS,
PORTABLE FORGES.
TIRE BENDERS & SHRINKERS.
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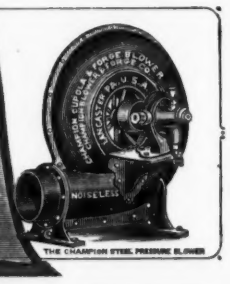
LANCASTER, PA. U.S.A.


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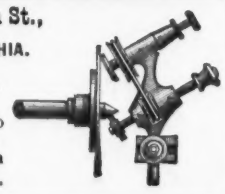
MANUFACTURERS OF
QUICK LIFTING AND LOWERING ROPE HOISTING MACHINES.
Adjustable Clamping Blocks, Drill Guides, Elevators, Etc.
PATENT CENTER GRINDERS Guaranteed to do accurate work.
Will grind Lathe Centers true if sprung or broken, quicker than they can be turned and filed. SEND FOR CATALOGUE.


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Drawing Materials, Surveying Instruments, &c.
Paragon Drawing Instruments, Extra and Best Quality, German Drawing Instruments, Paragon, Duplex, Universal, Anvil Drawing, Helios, Blue Process Papers, Scales, Triangles, T-Squares, Drawing Boards, Standard Profile and Cross-section Papers. Catalogue to professional people on application.

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A new Patent Application of Ball Bearing, patented Dec. 2, 1890, to Drill Presses, Lathe and all end thrust of Horizontal Shafts in Machinery. 95 per cent. of the friction overcome by this device. Full satisfaction guaranteed.
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Complete Outfits for Bolt Shops.
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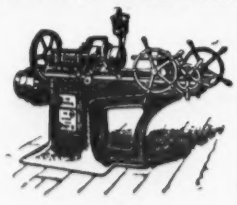

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BUILDERS OF
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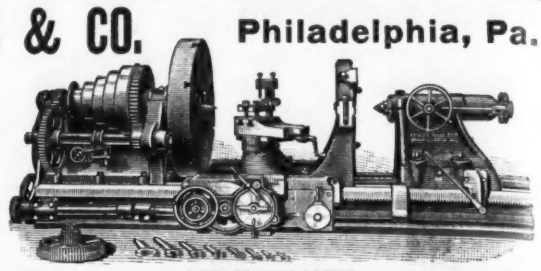
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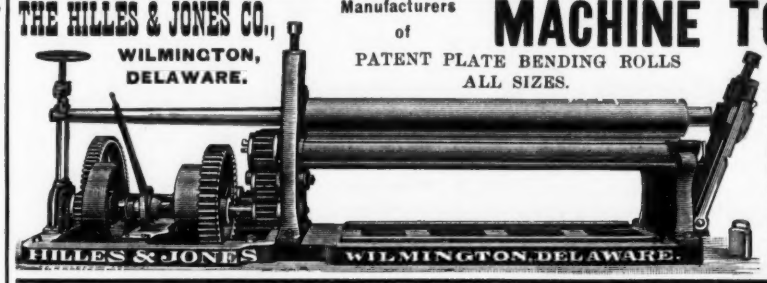

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STEEL CASTINGS
FROM 1-4 TO 15 000 LBS. WEIGHT.
True to pattern, sound, solid, free from blow-holes and of great strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
60,000 CRANK SHAFTS and 50,000 GEAR WHEELS of this steel now running prove this.
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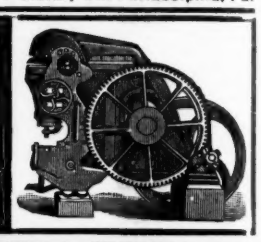

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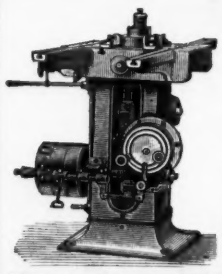
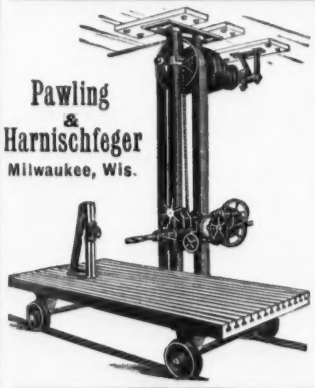
You will make a mistake that will cost you money.

THE MORTON Lightning Key-Way Cutter is the only machine on the market that will cut a Key-Way and make a Key to fit it. Mr. Geo. Newcomb, Salem, Mass., says as follows: "The Key-maker is a wonderful attachment, making keys faster than a man can cut off the steel for it. The Key-Way Cutter does a piece of work in fifteen minutes which requires my man seven hours to accomplish by hand." We build machines with stroke varying from six inches to five feet, and cutting from the smallest Key-ways to six inches wide. **MORTON MFG. CO.,** Muskegon, Mich.
Formerly of ROMEO, MICH.


KEY SEATERS
Portable and Stationary.
Back-Cutting Attachment
Key-Making Machines.
Giant Key-Seater Co.
EAST SAGINAW, MICH.
April 25, 1891. We are very much pleased with it, and think it the best machine on market for simplicity and effective work. DAVIS & COWGILL IRON WORKS, Omaha, Neb.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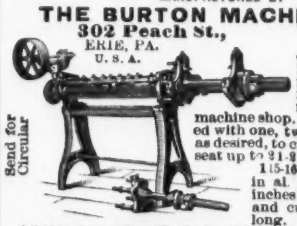
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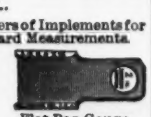
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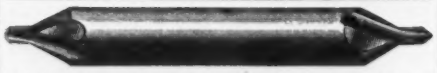
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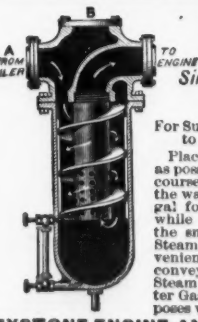

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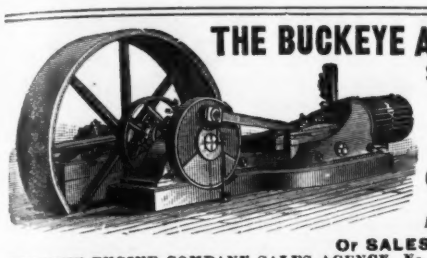

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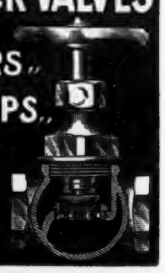

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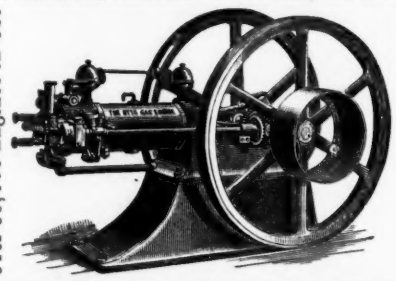

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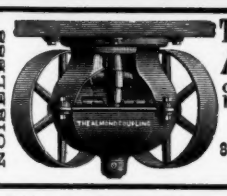

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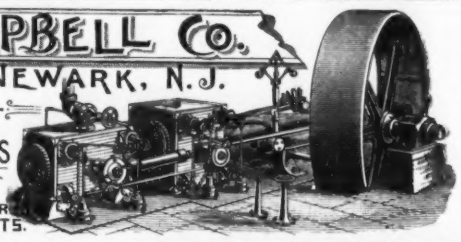

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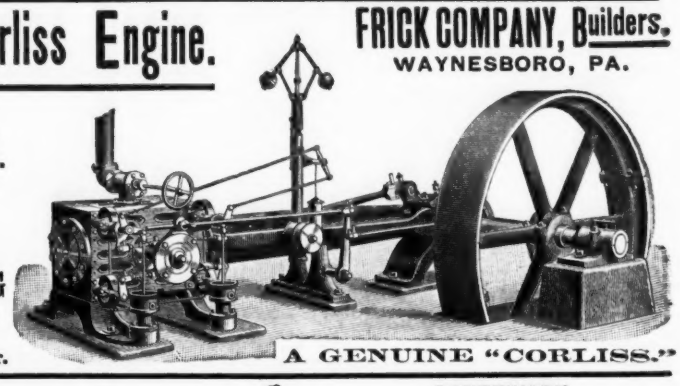

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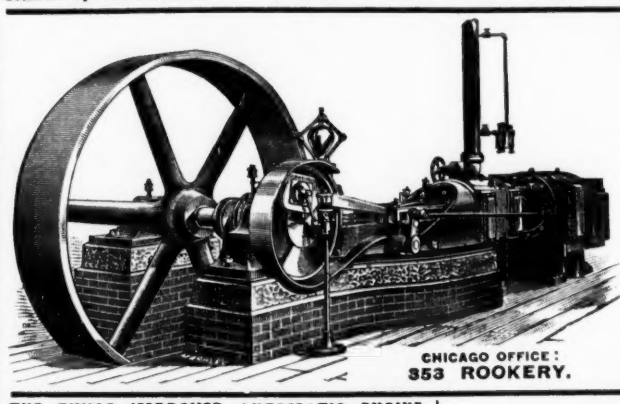

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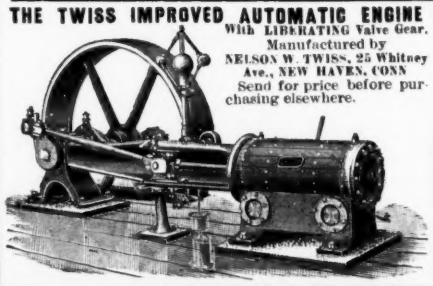

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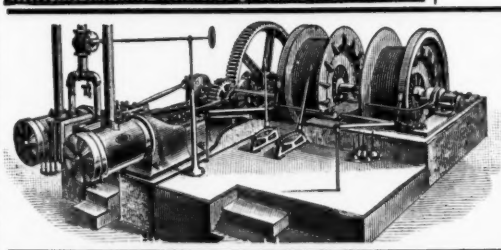

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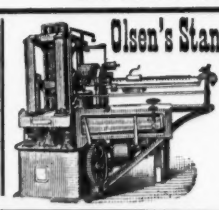

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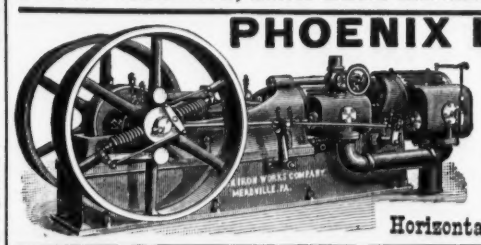

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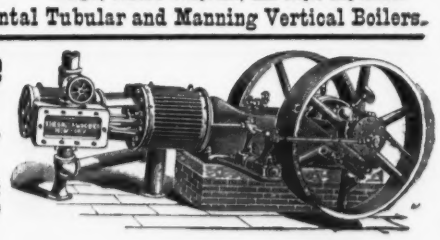

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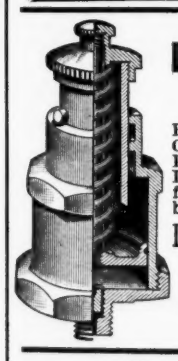

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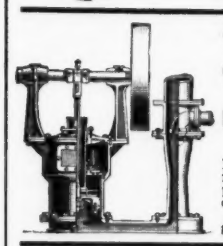

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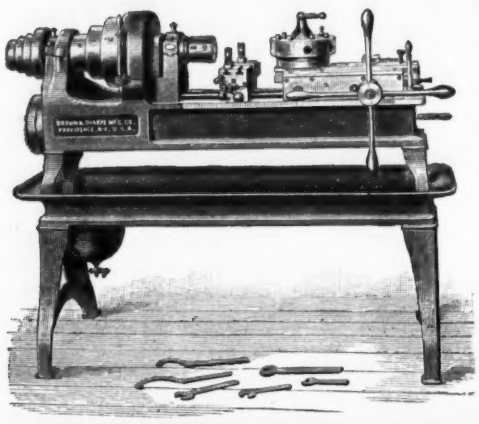

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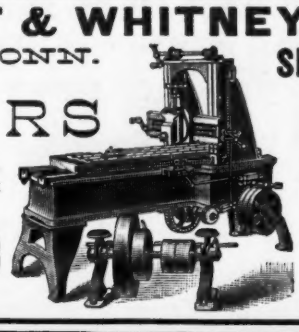

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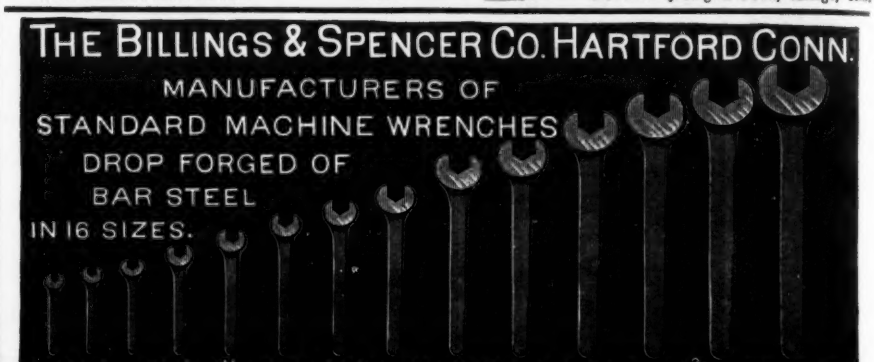

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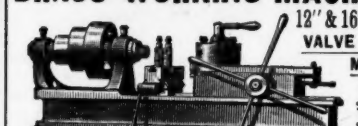

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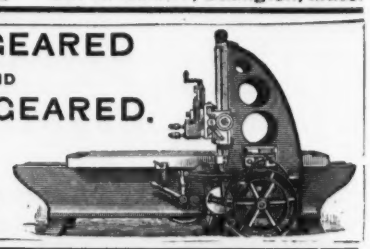
PLANERS

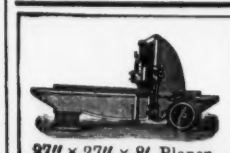
SPUR GEARED AND SPIRAL GEARED.

MANUFACTURED BY

The G. A. GRAY CO.,

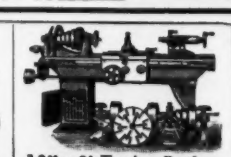
479 Sycamore St., CINCINNATI, O.





27" × 27" × 8' Planer.

20" × 6' Chucking Lathe.



16" × 6' Engine Lathe.

25" Pillar Shaper.
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